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Layne et al.

(10) **Patent No.: US 6,669,355 B2**
(45) **Date of Patent: Dec. 30, 2003**

(54) **HOUSING ROTATION LOCK FOR A TRACK LIGHTING FIXTURE**

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(73) Assignee: **Cooper Technologies Company**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 83 days.

(21) Appl. No.: **09/917,206**

(22) Filed: **Jul. 30, 2001**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/221,563, filed on Jul. 28, 2000, provisional application No. 60/221,564, filed on Jul. 28, 2000, provisional application No. 60/221,565, filed on Jul. 28, 2000, provisional application No. 60/221,567, filed on Jul. 28, 2000, provisional application No. 60/221,568, filed on Jul. 28, 2000, provisional application No. 60/221,569, filed on Jul. 28, 2000, and provisional application No. 60/221,570, filed on Jul. 28, 2000.

(51) **Int. Cl.**[7] **F21V 29/00**
(52) **U.S. Cl.** **362/294**; 362/362; 362/374; 215/217
(58) **Field of Search** 362/294, 362, 362/364, 365, 366, 374, 375, 546, 549; 215/217, 222

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Primary Examiner—Stephen Husar
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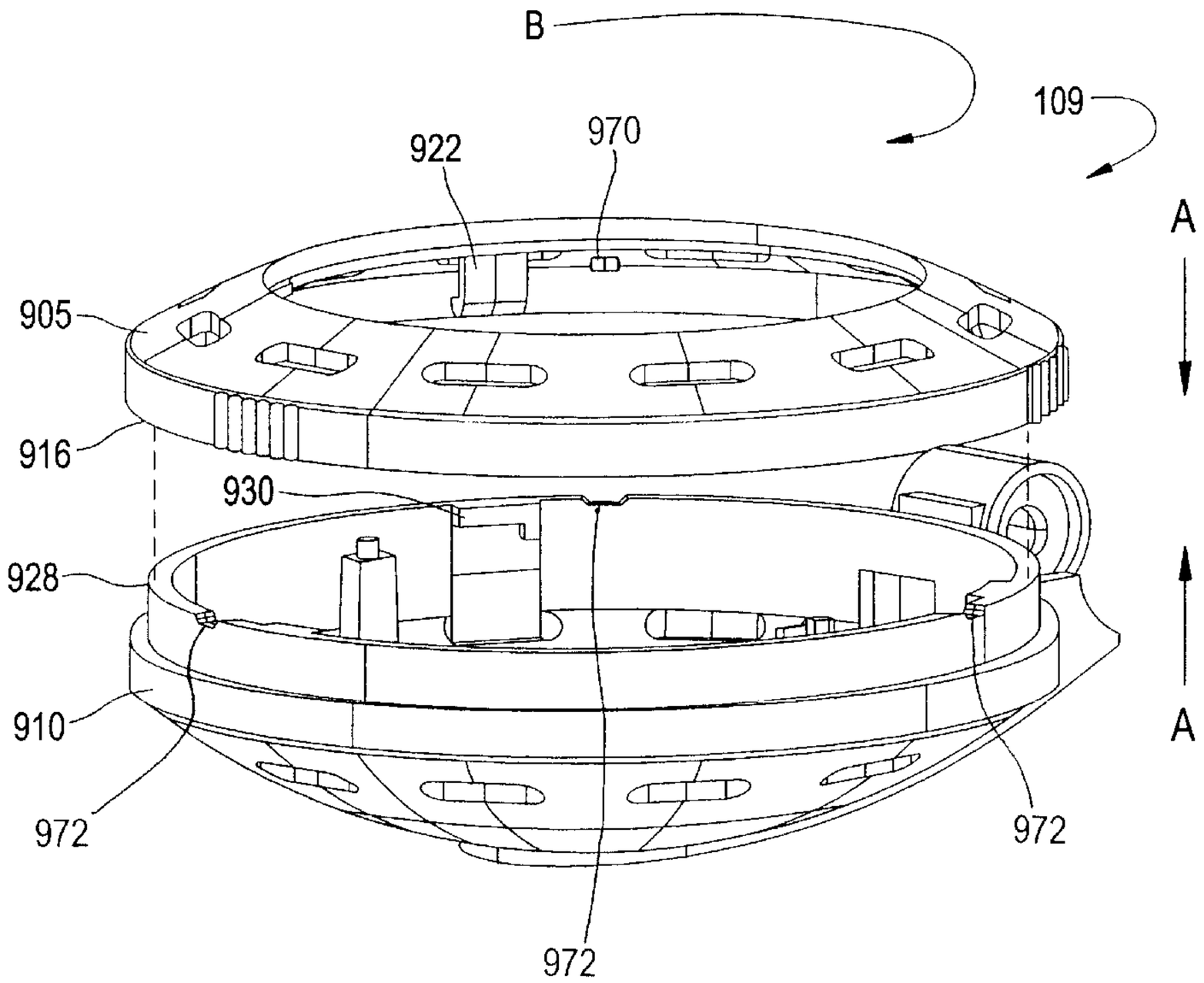
(57) **ABSTRACT**

A track lighting fixture includes a first housing half and a second housing half. The first housing half includes a surface, an inner perimeter, a recess in the surface, and mating ramps extending from the inner perimeter. The second housing half includes a surface, a protrusion extending from the surface, and mating arms extending from the surface.

23 Claims, 32 Drawing Sheets



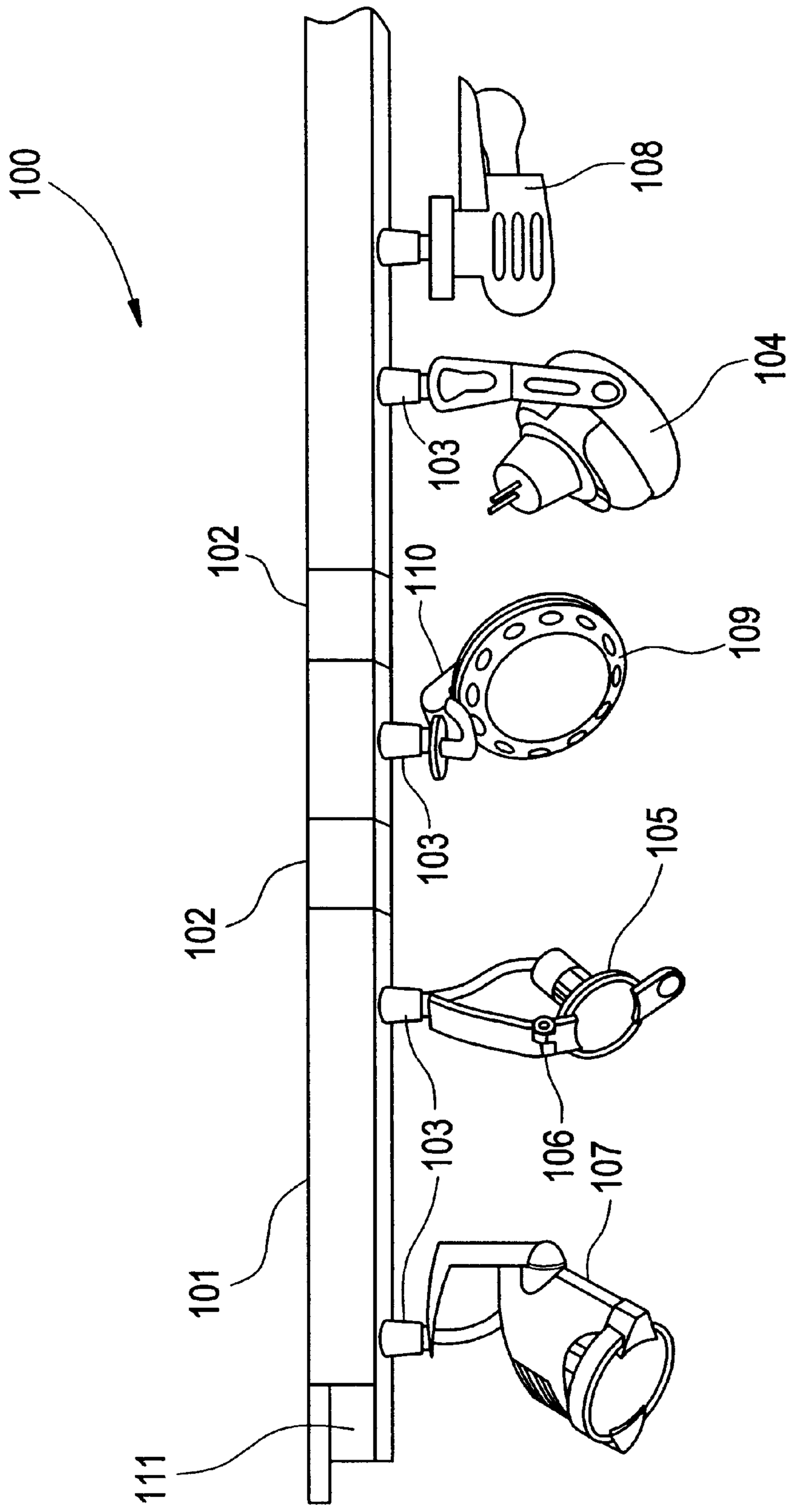


FIG. 1

FIG. 2A

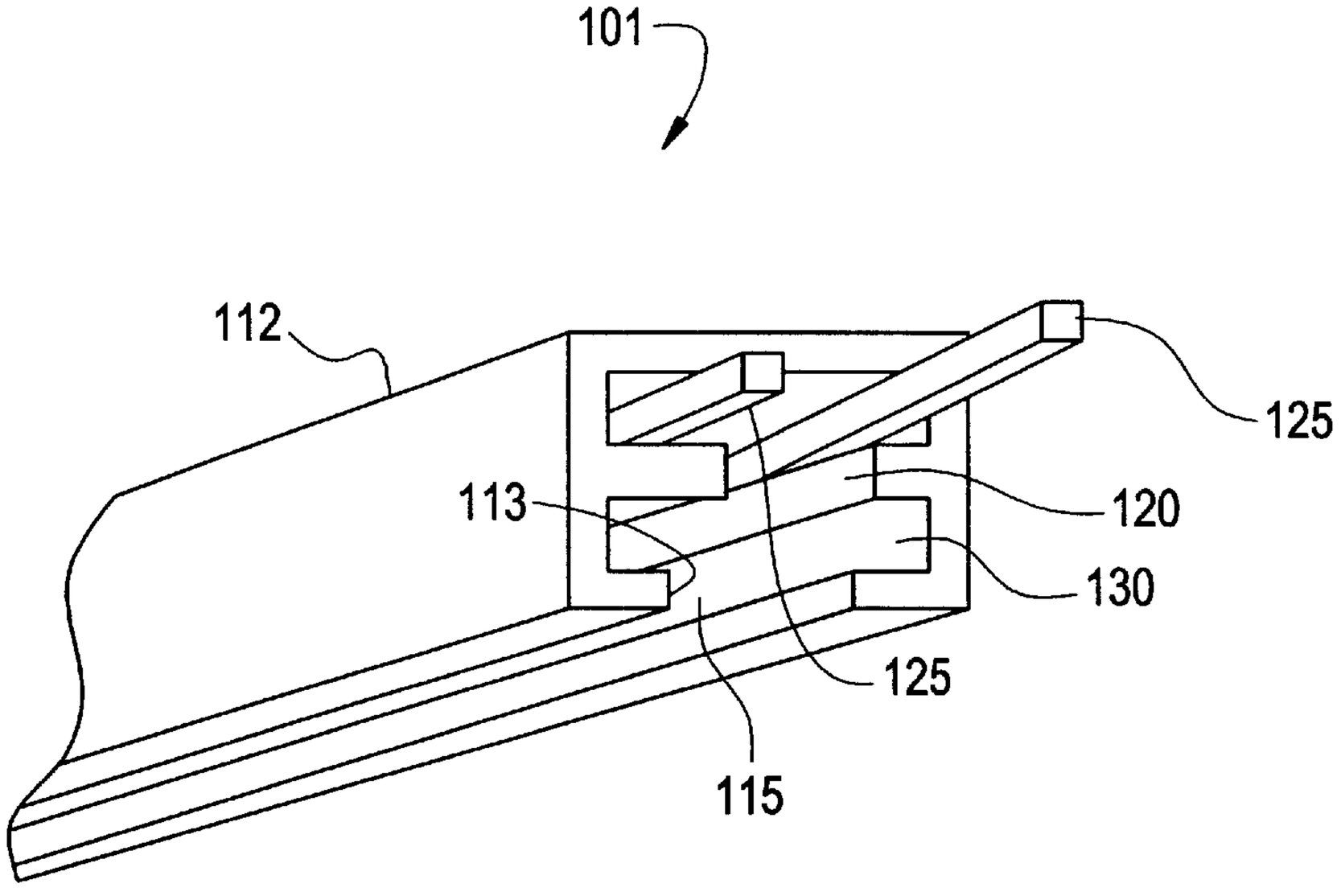

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FIG. 2B

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FIG. 3

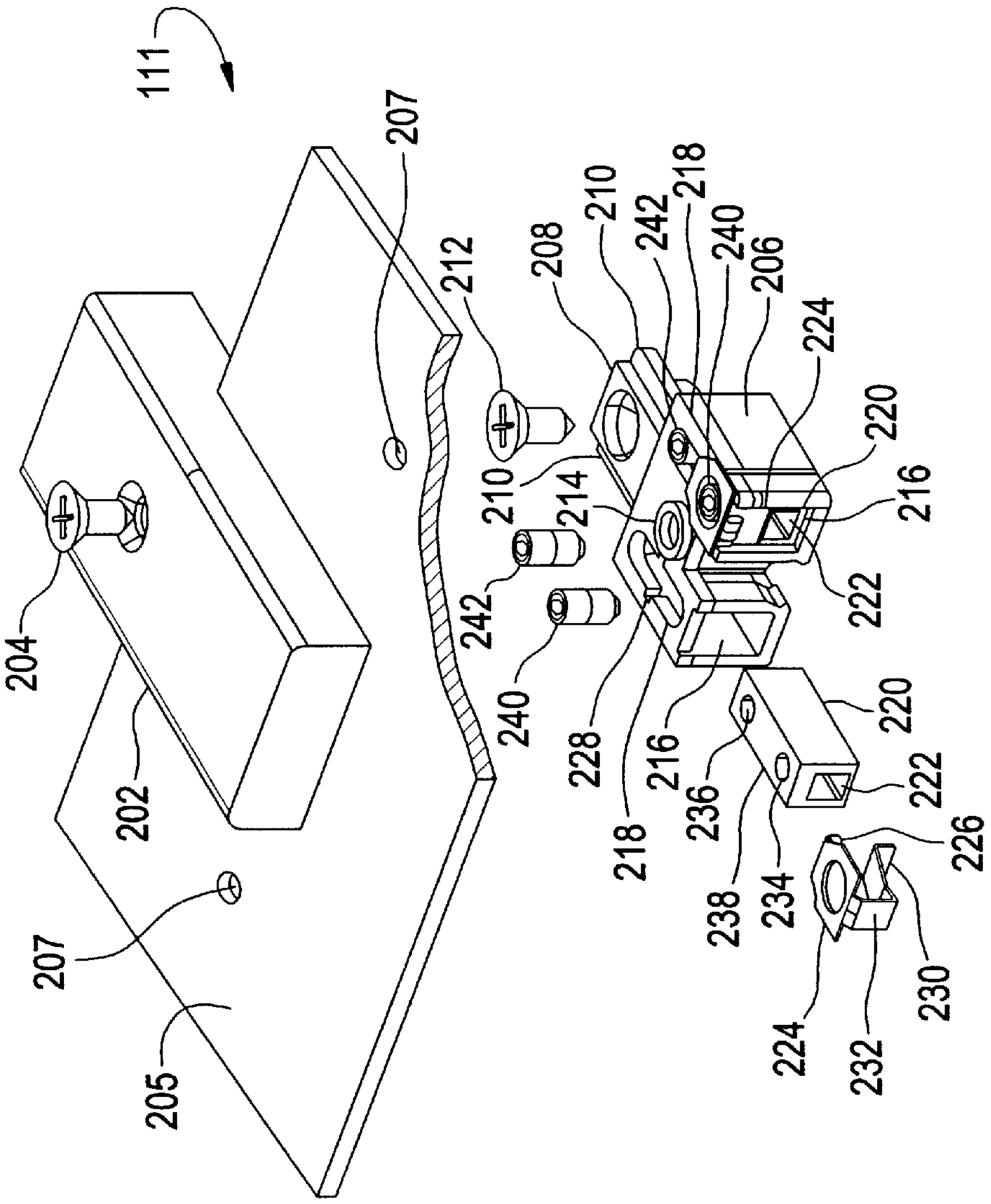
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FIG. 4

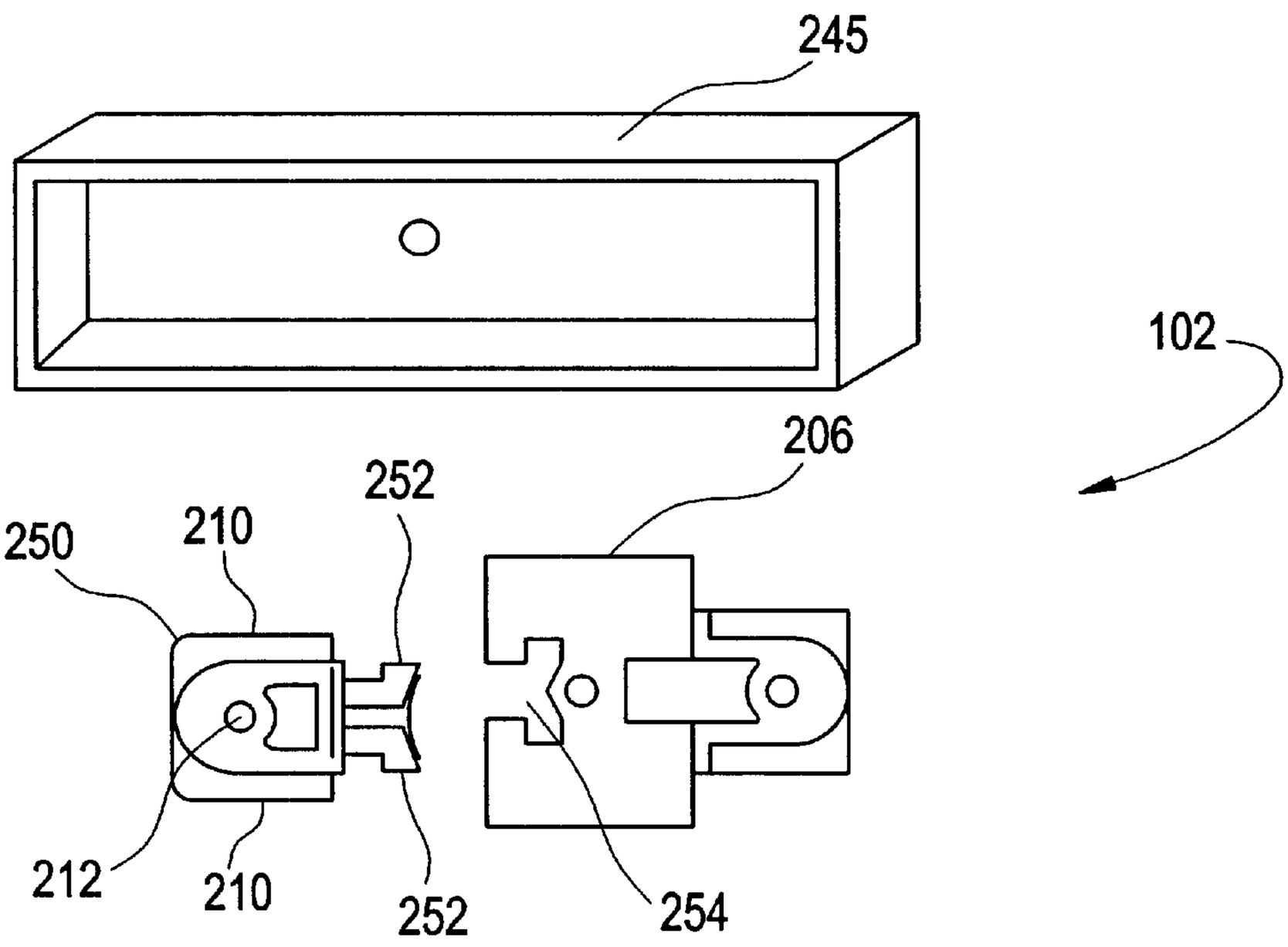

FIG. 5

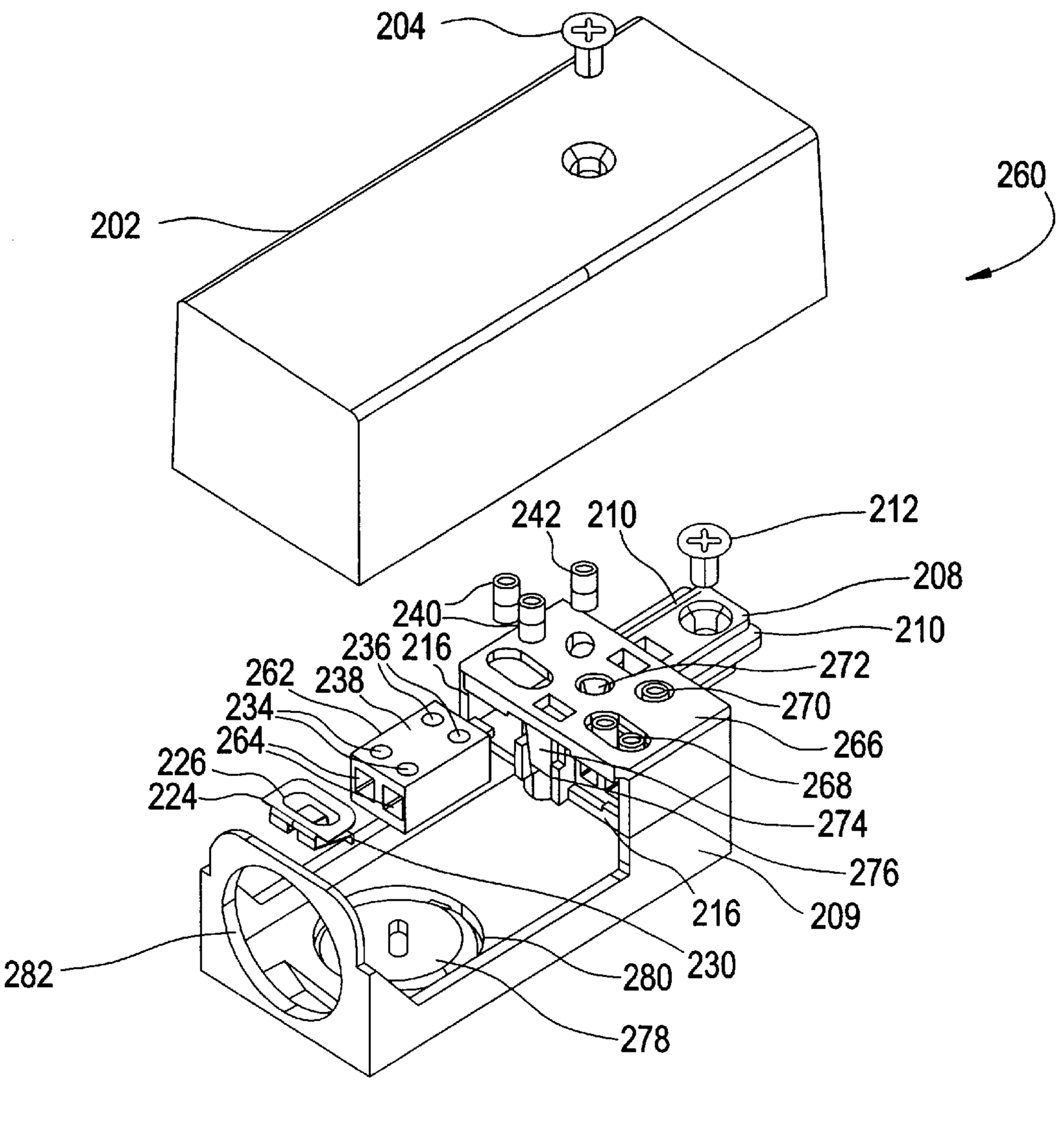
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FIG. 6

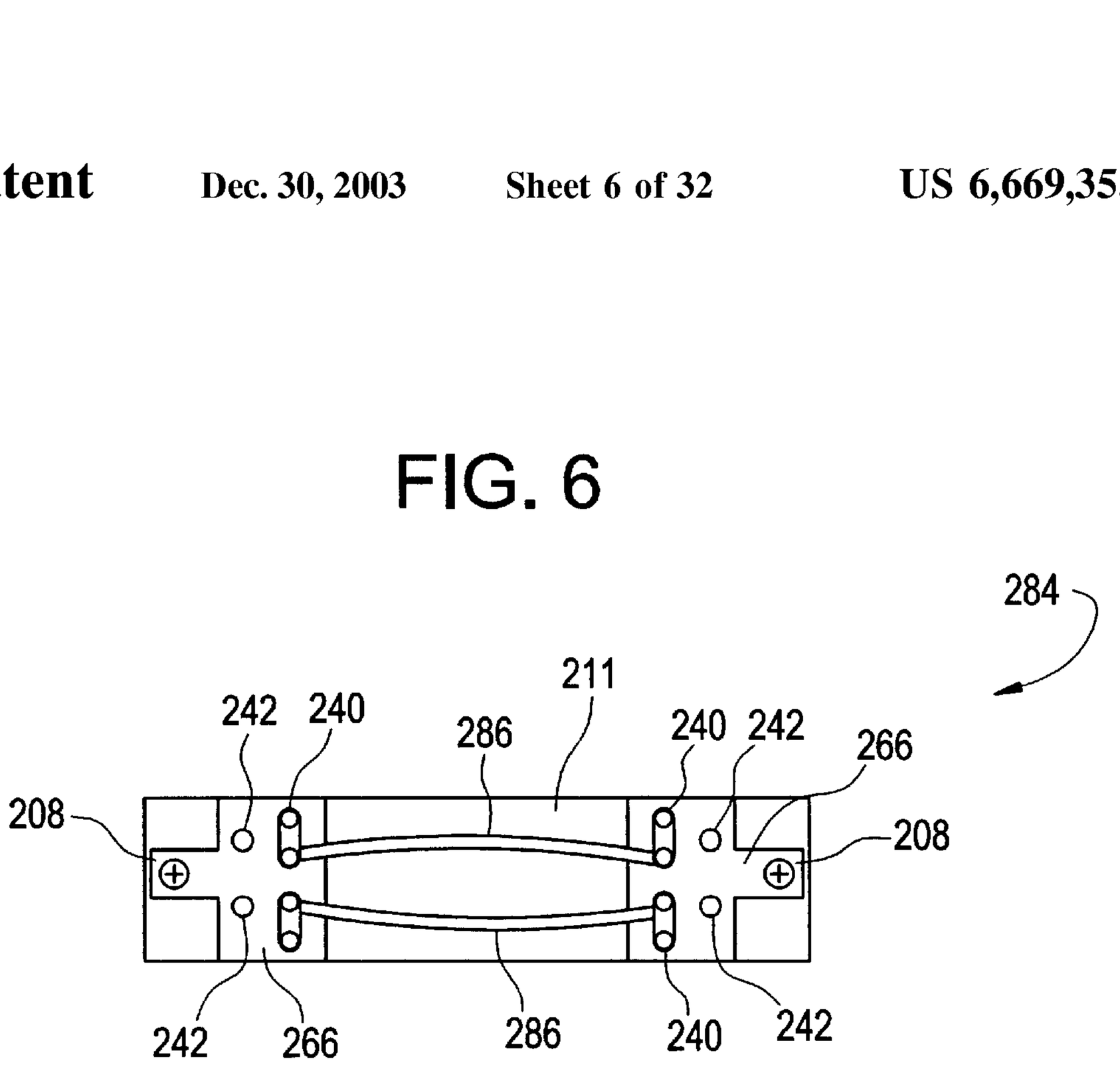
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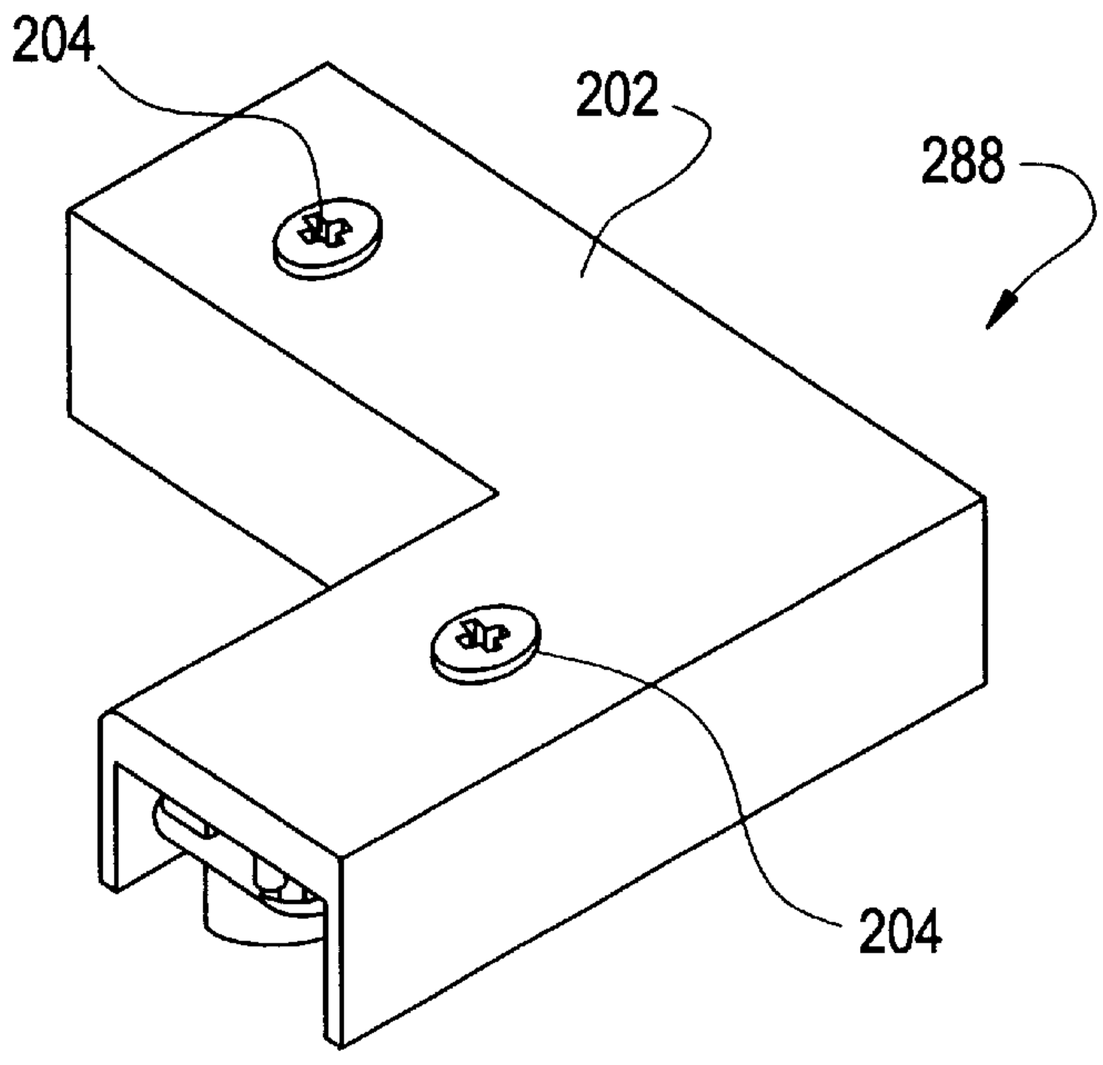
FIG. 7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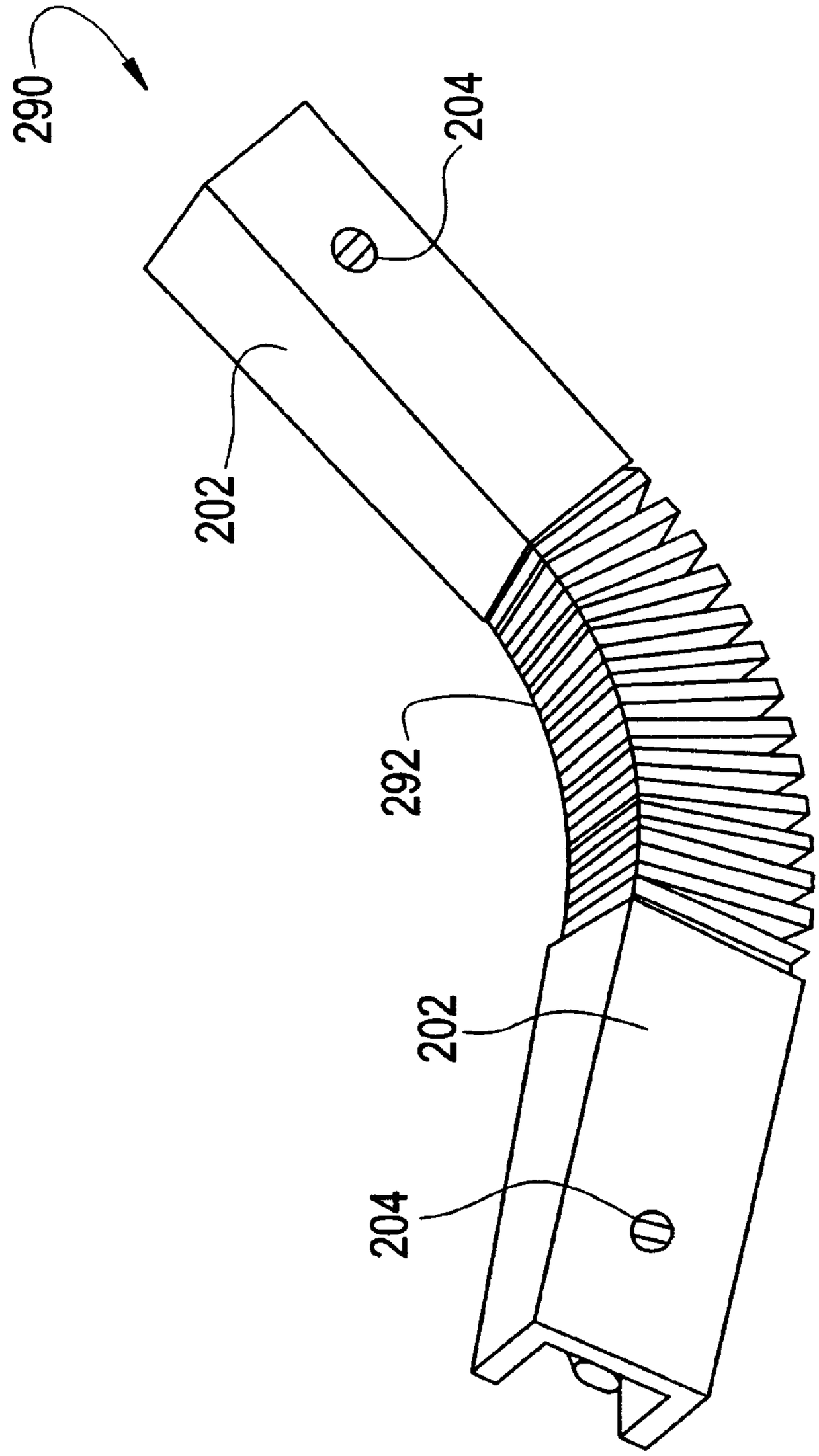

FIG. 8

FIG. 9

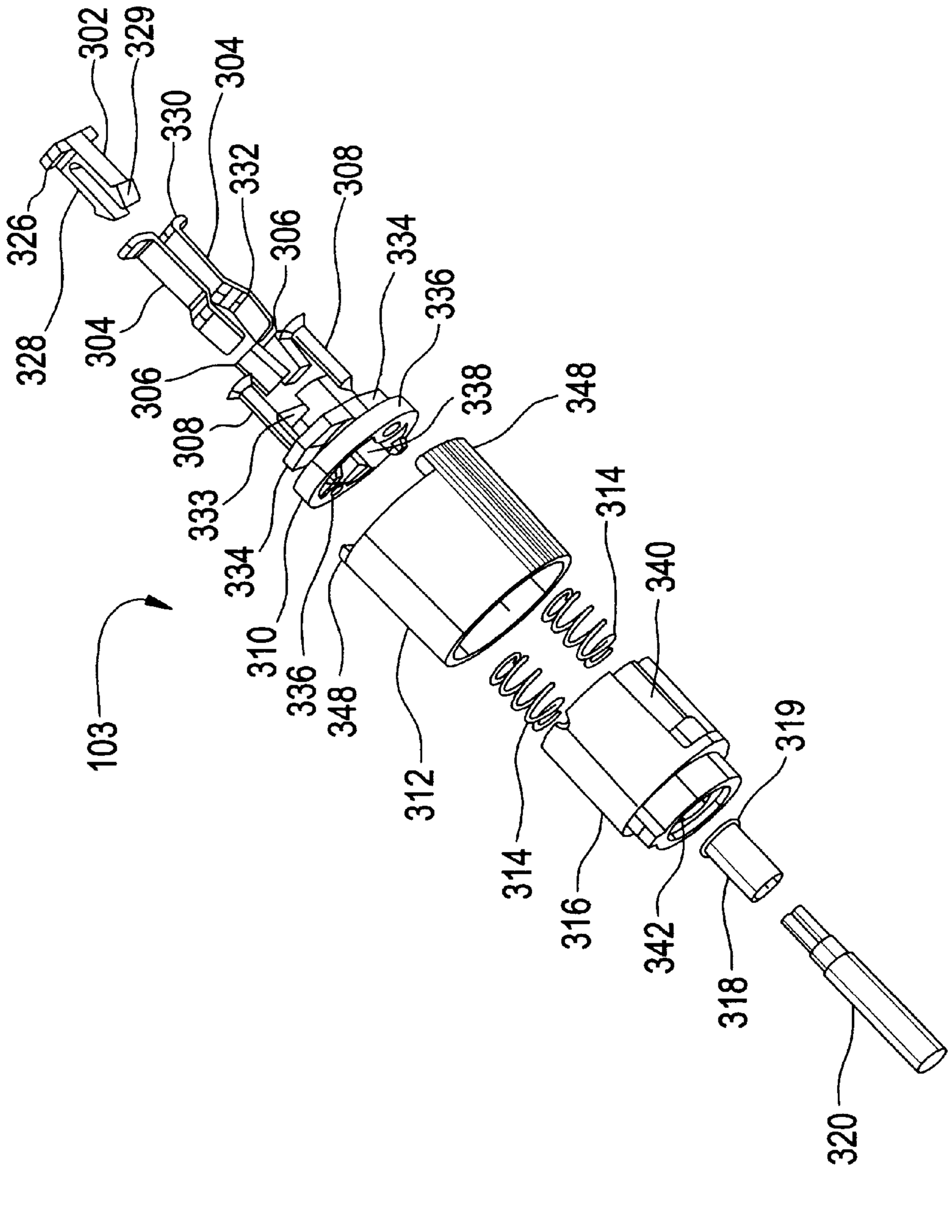
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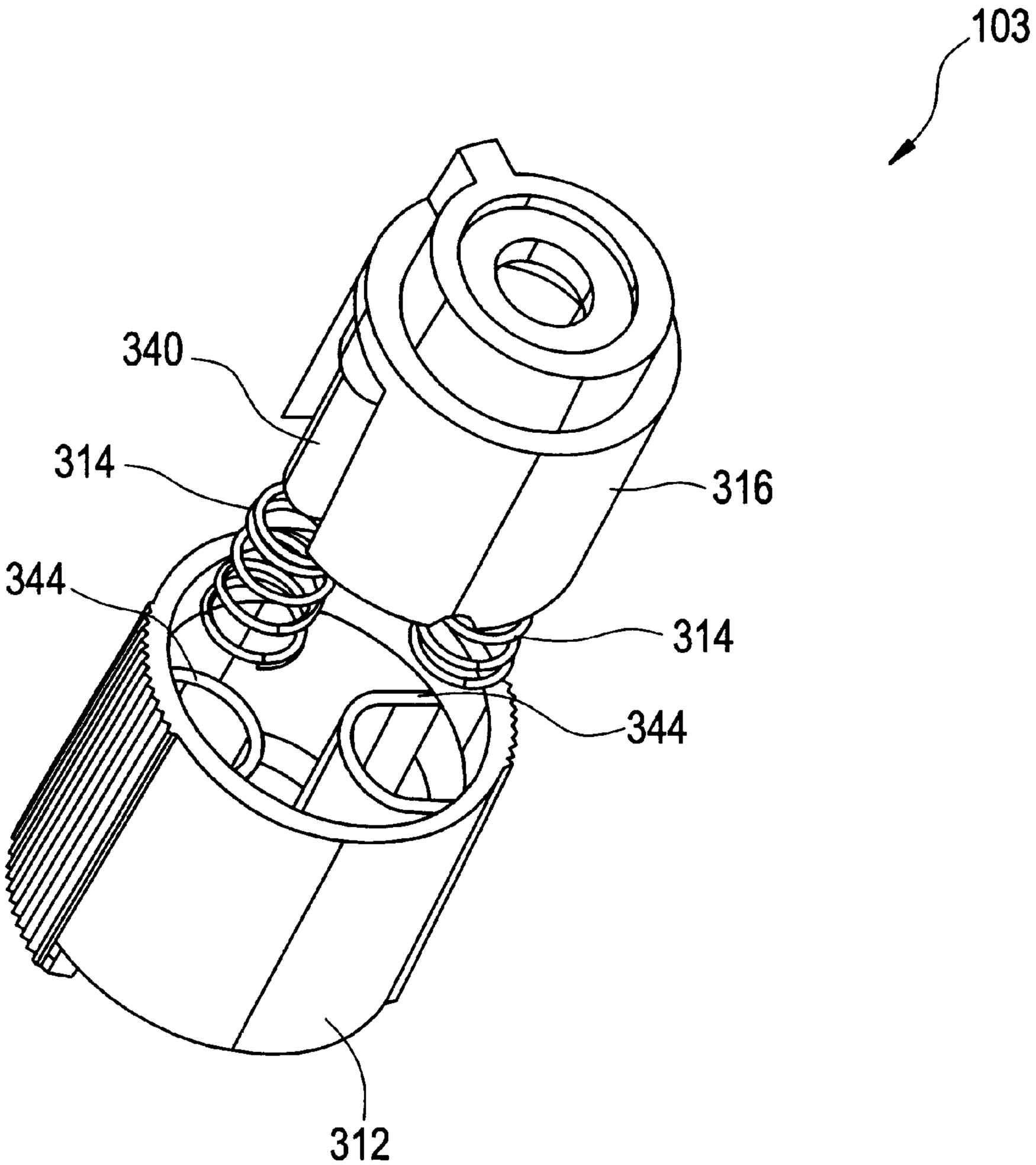
FIG. 10



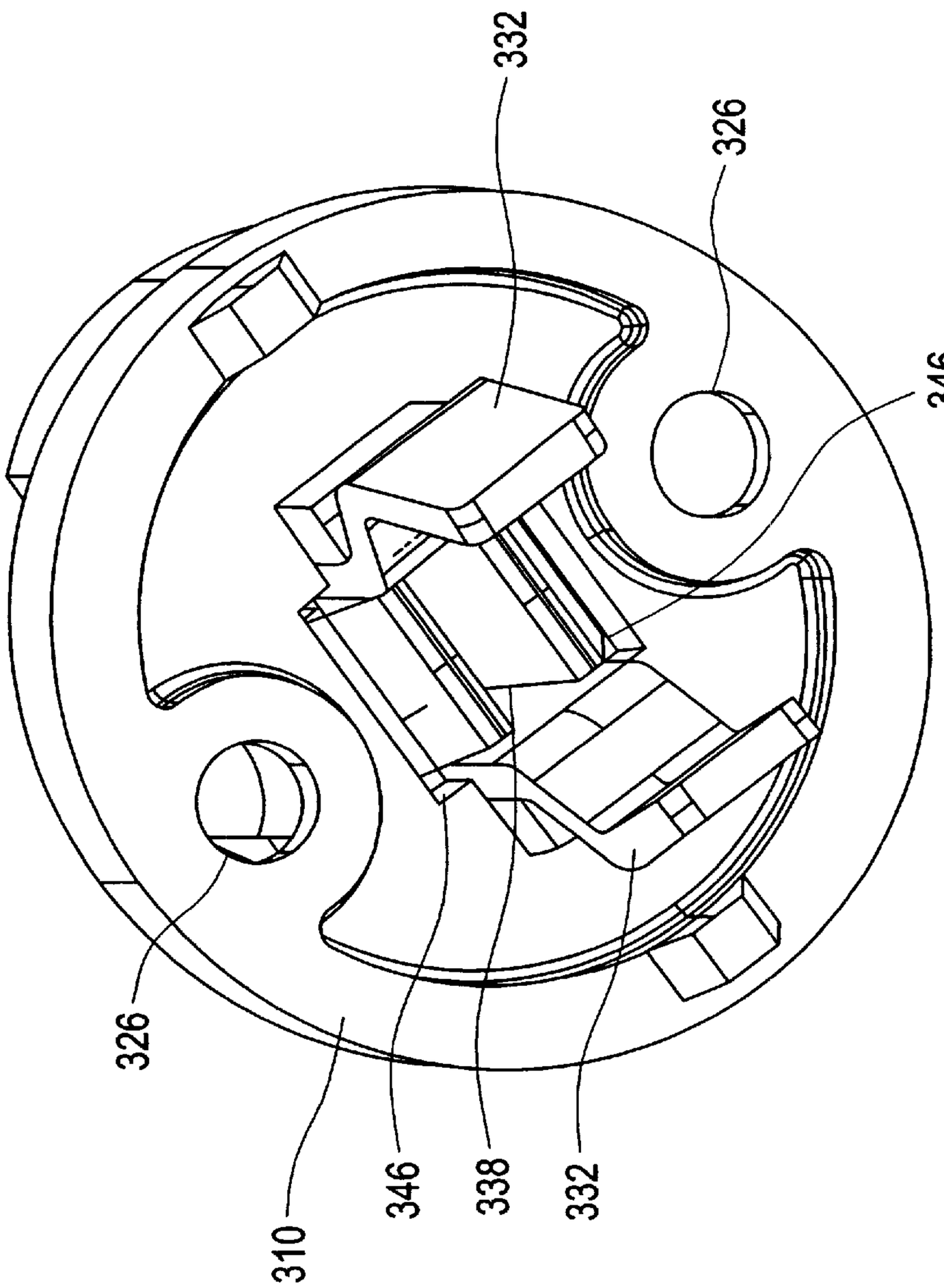


FIG. 11

FIG. 12

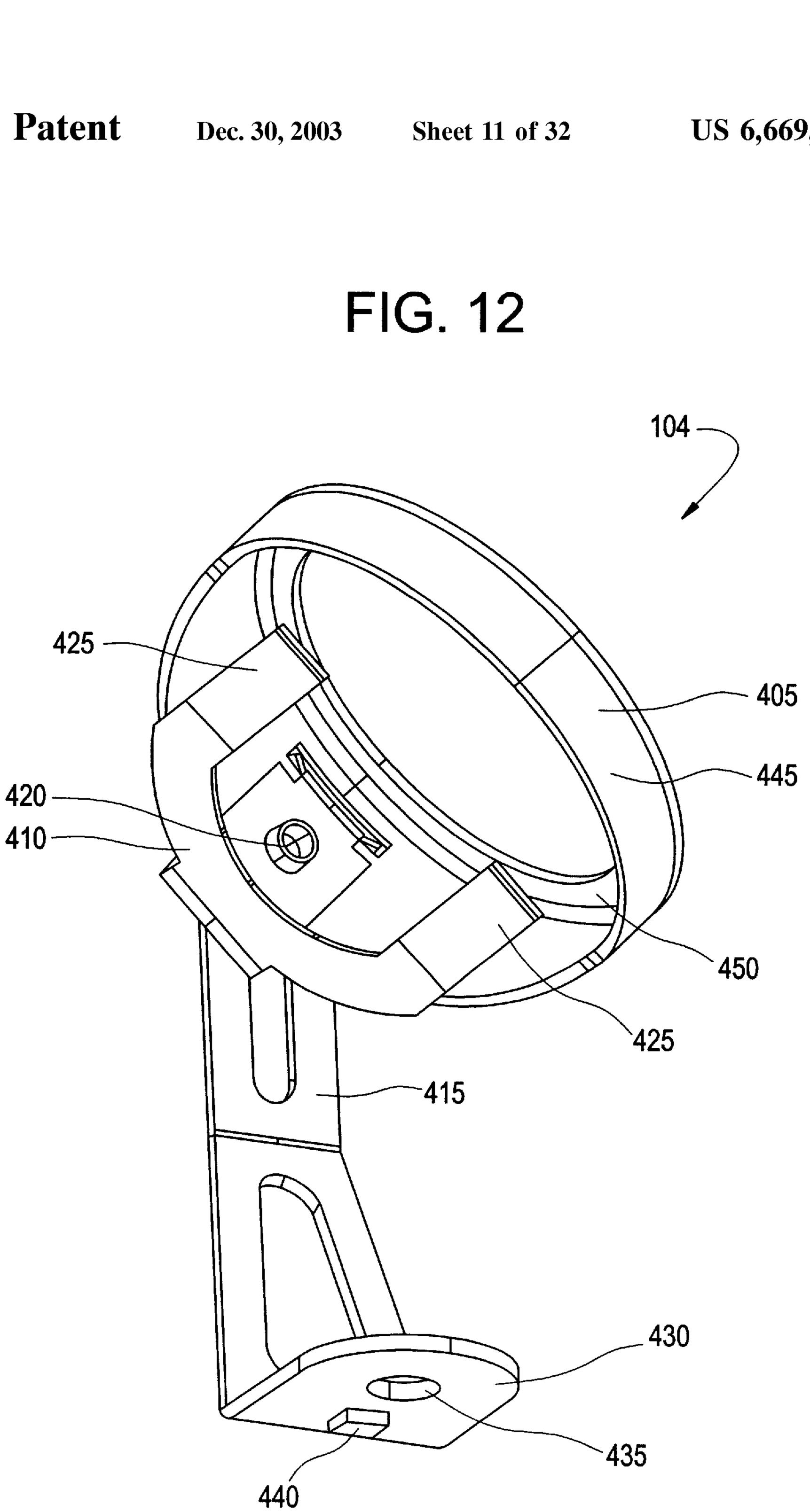


FIG. 13

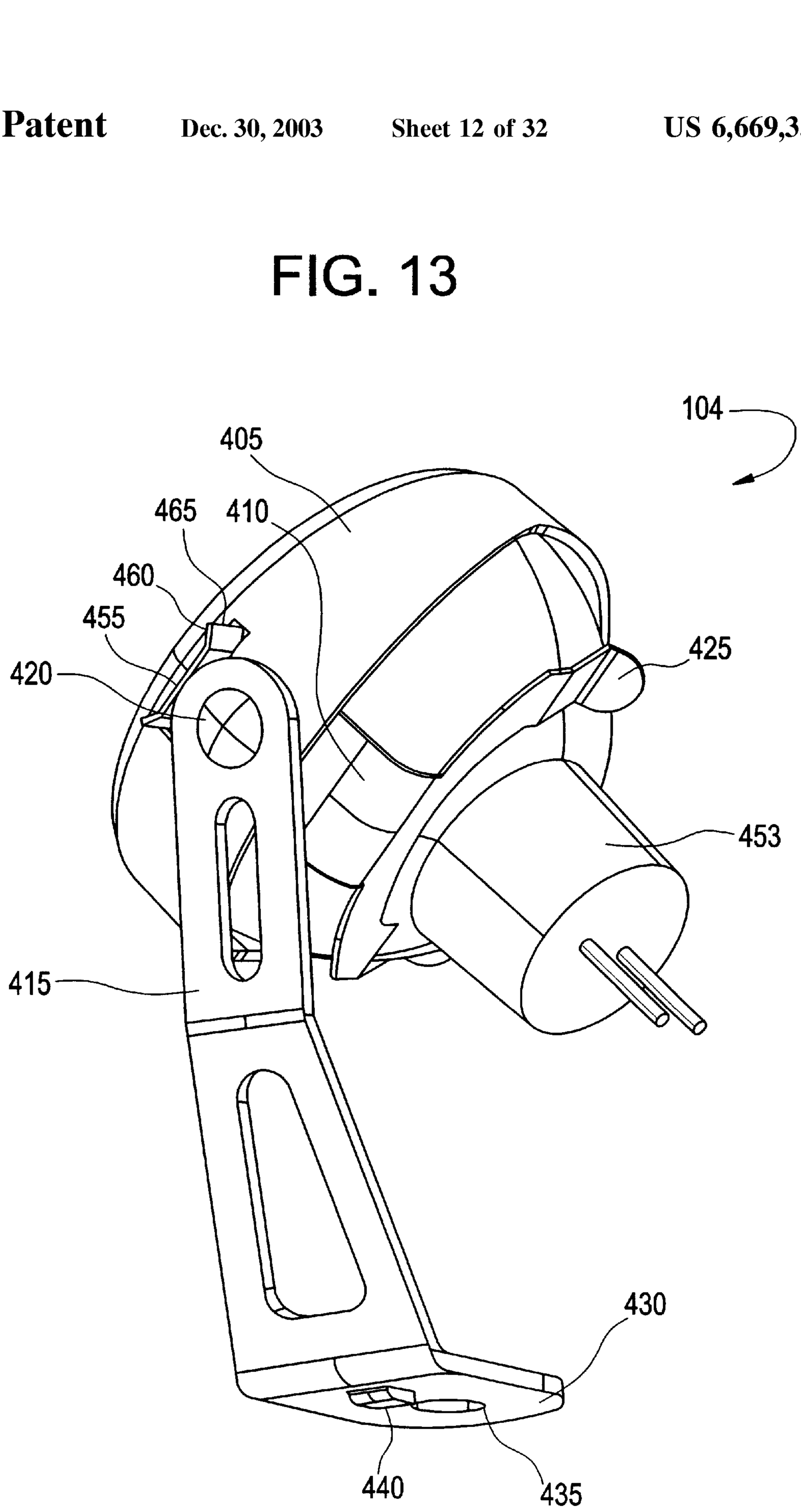
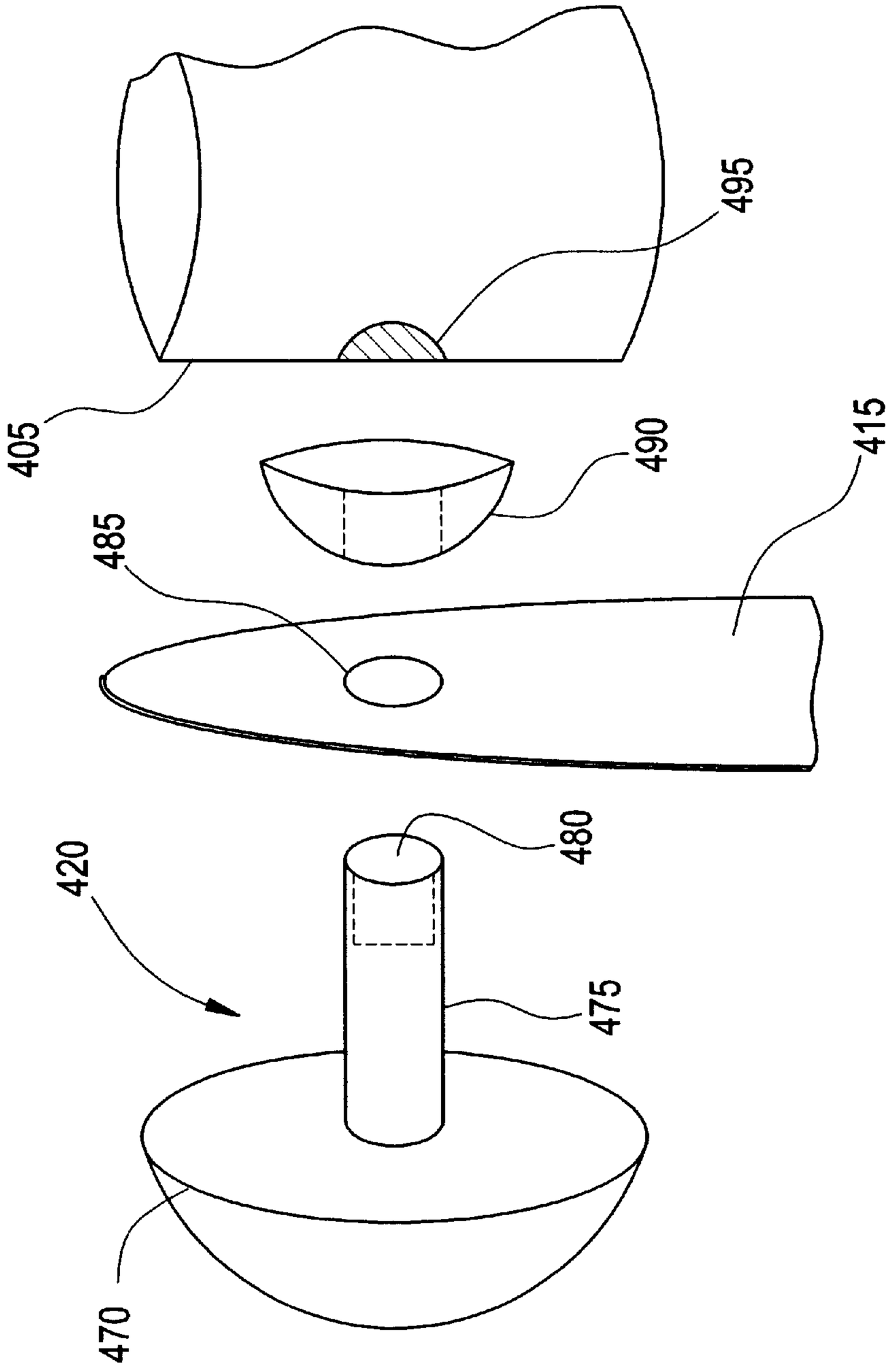


FIG. 14



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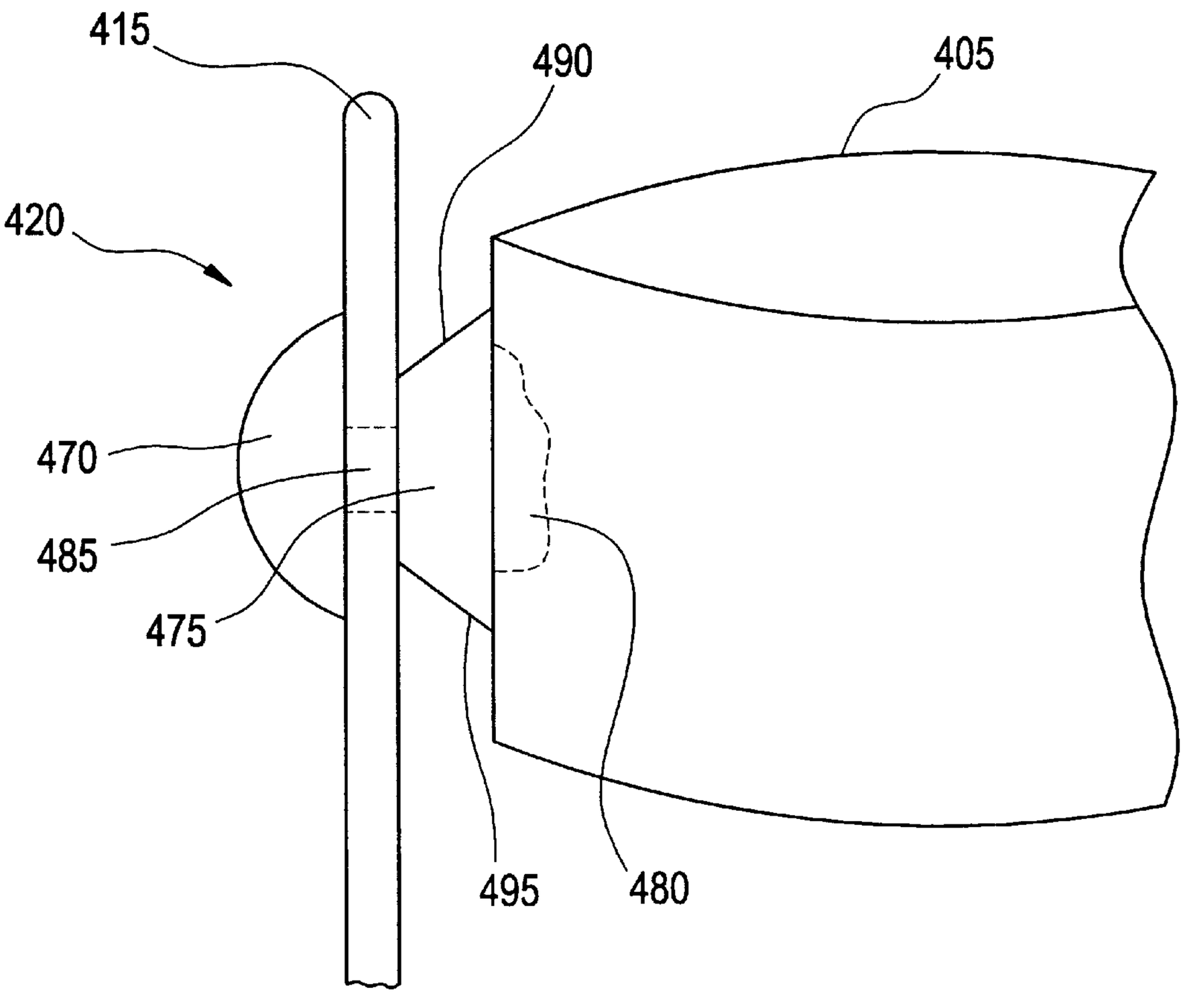

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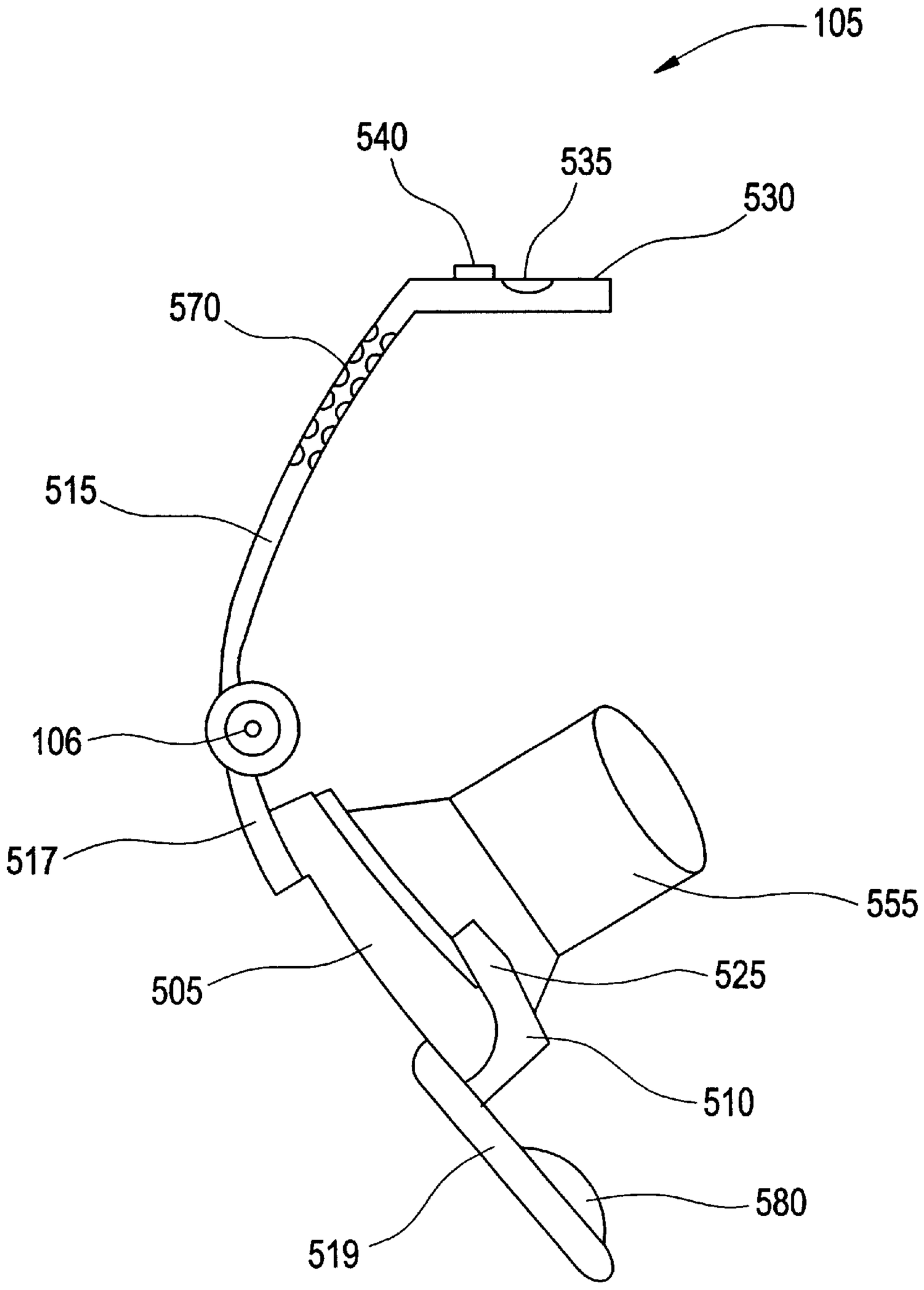

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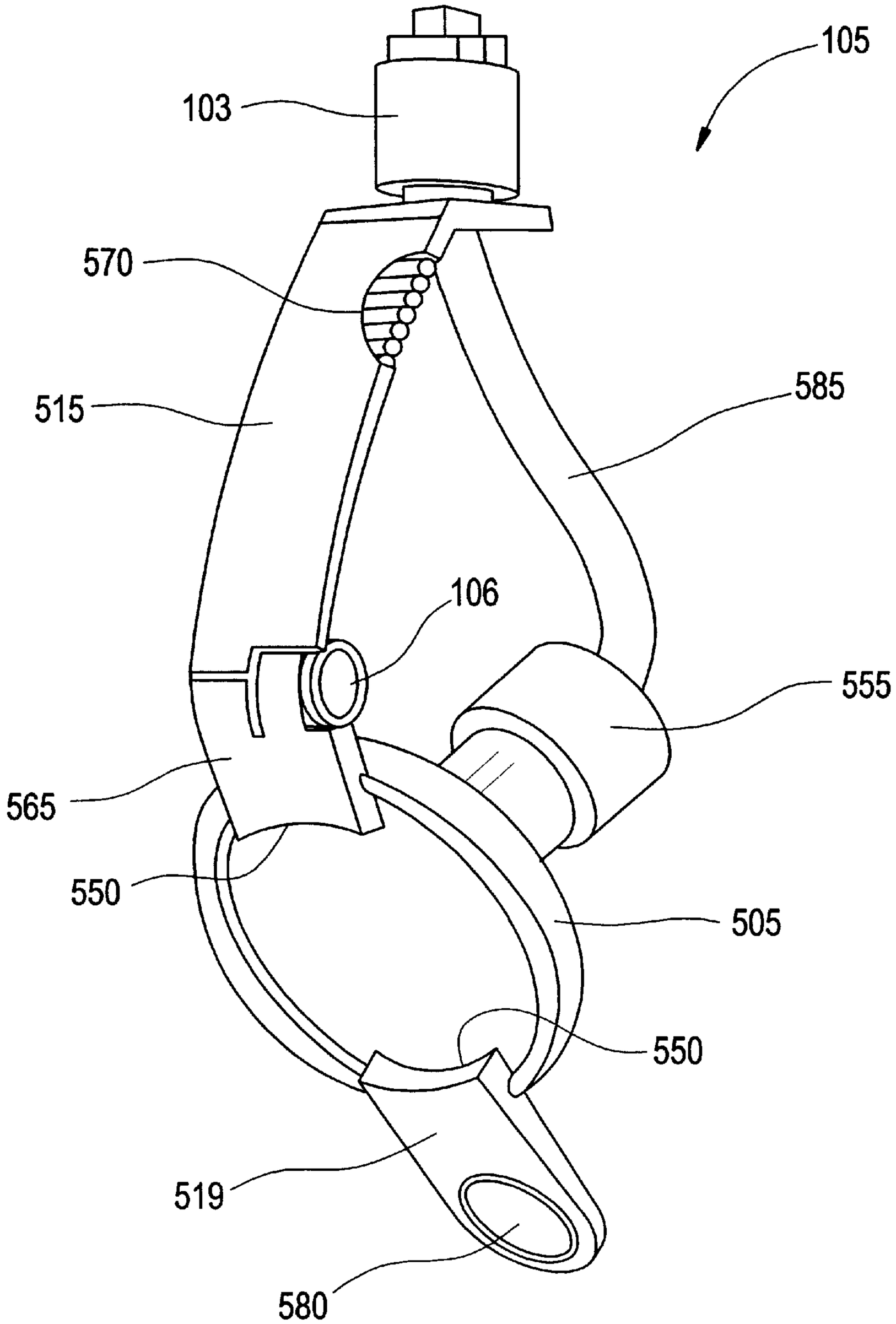

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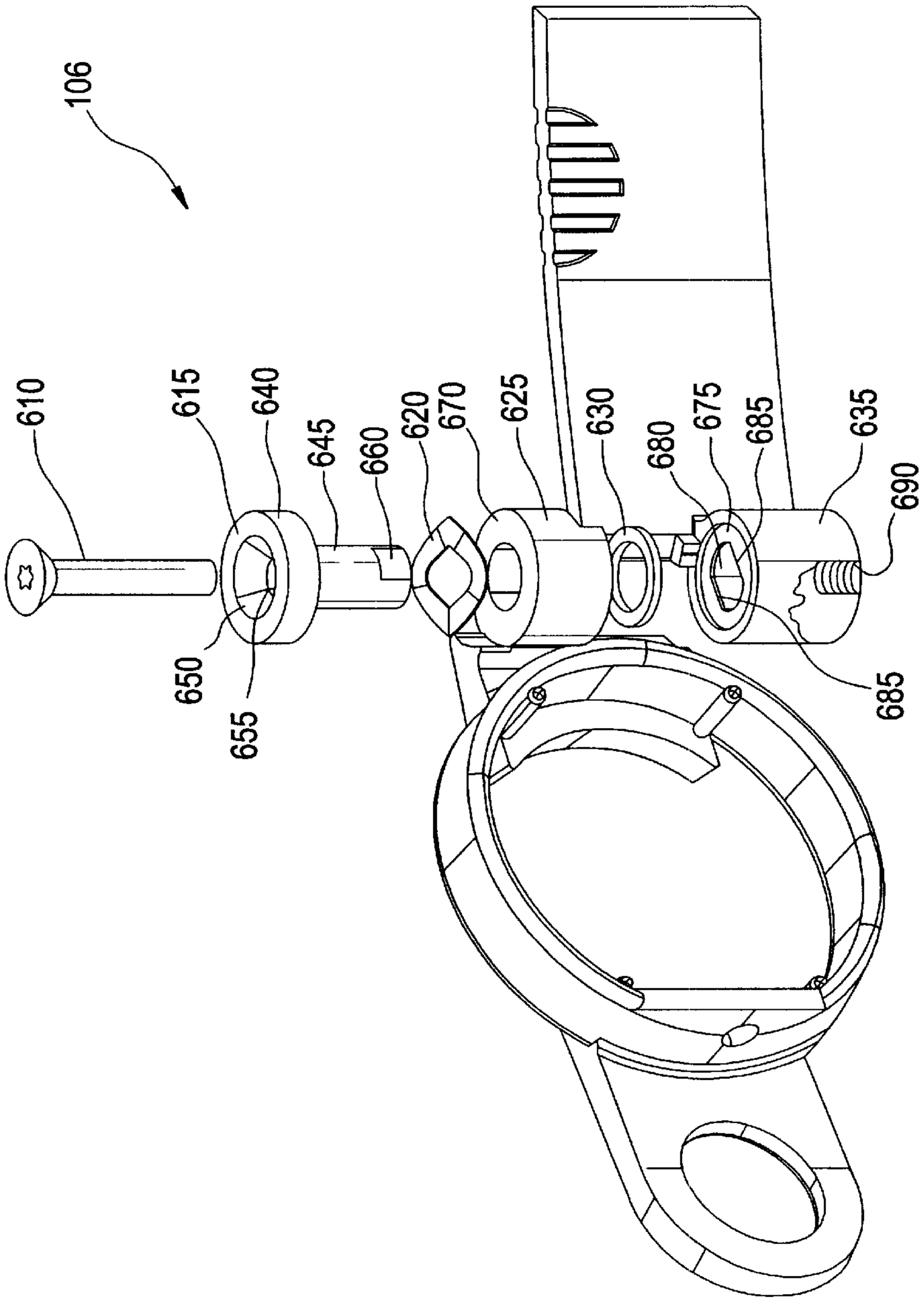
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FIG. 19

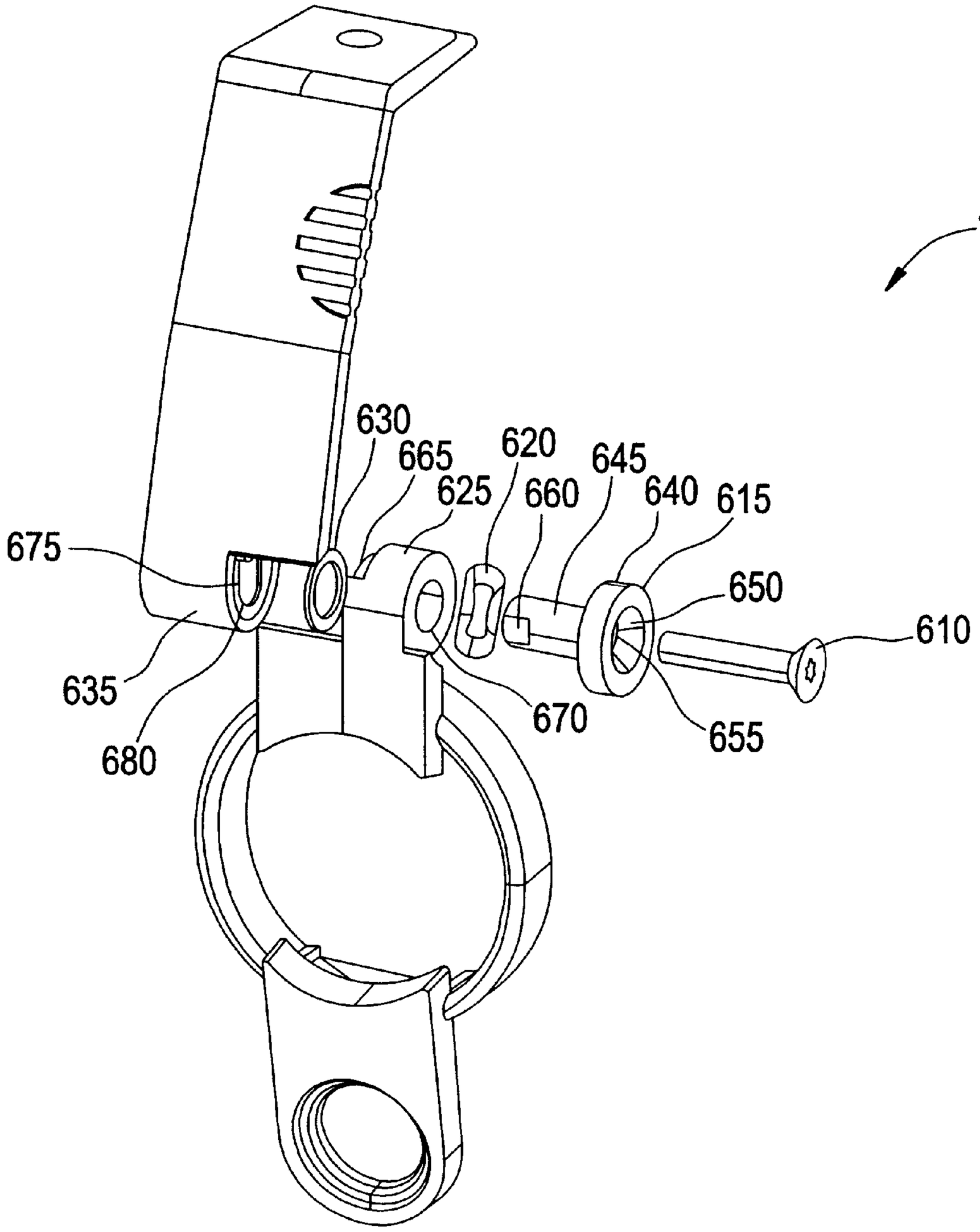

FIG. 20

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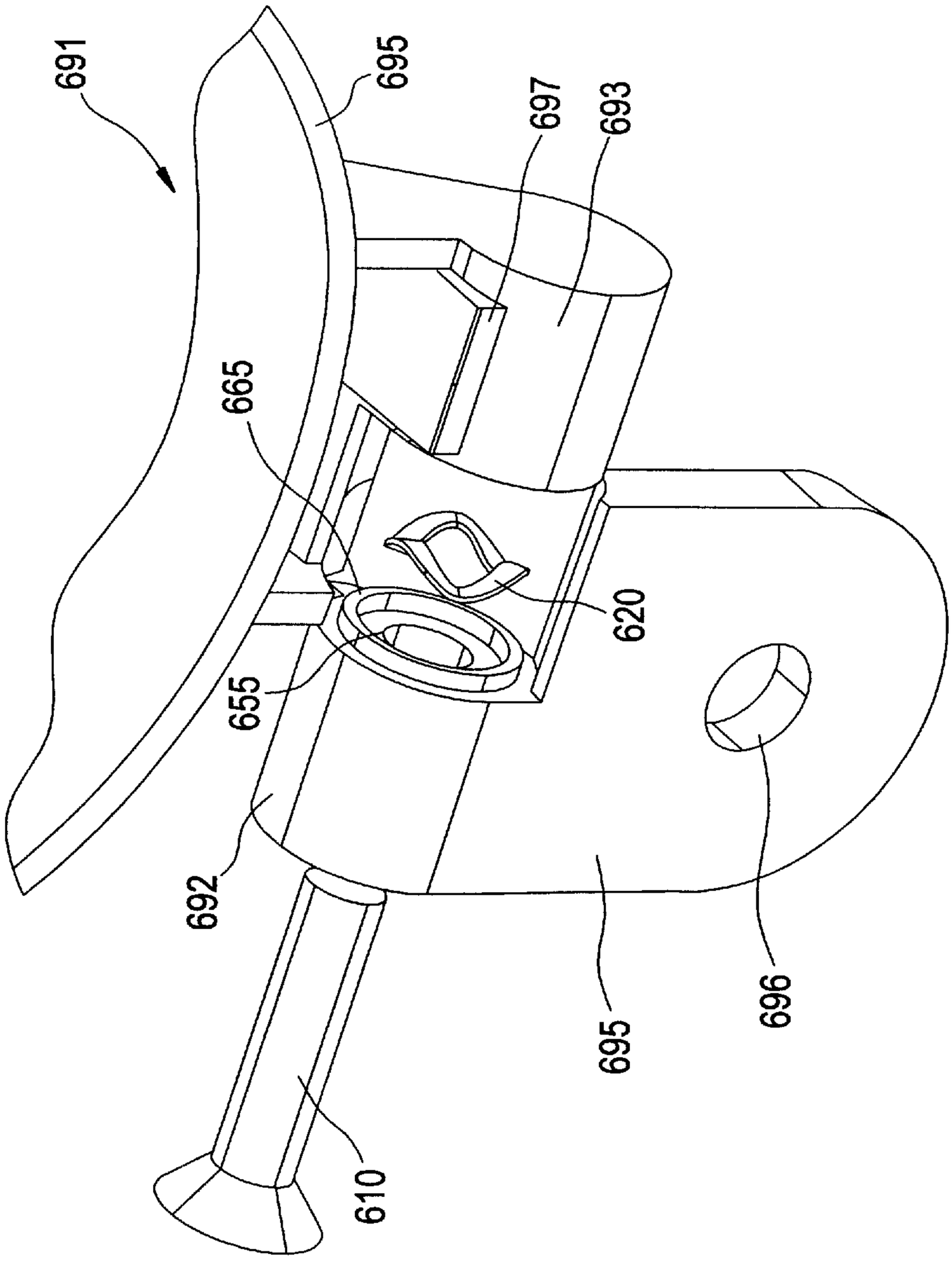

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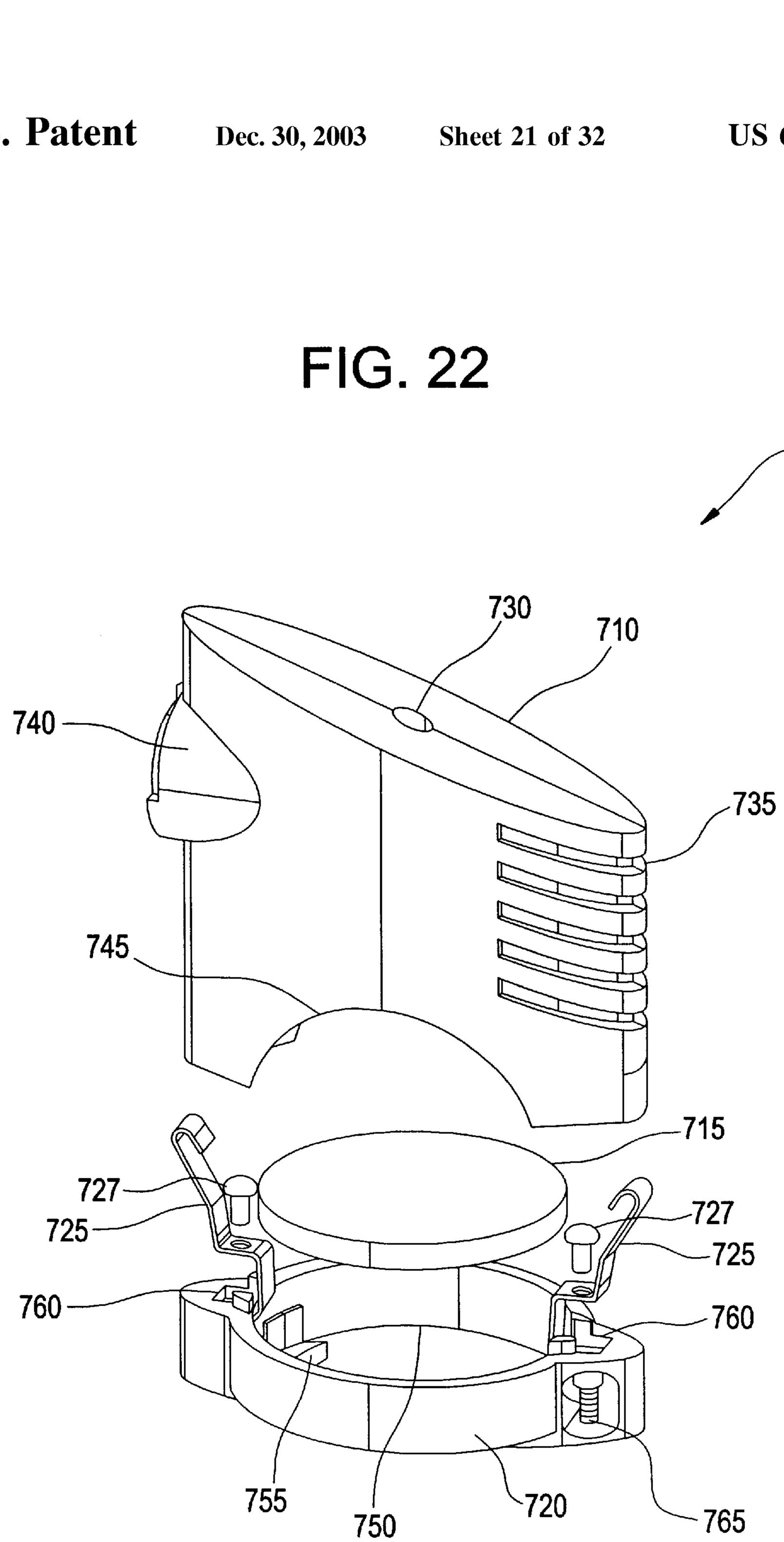
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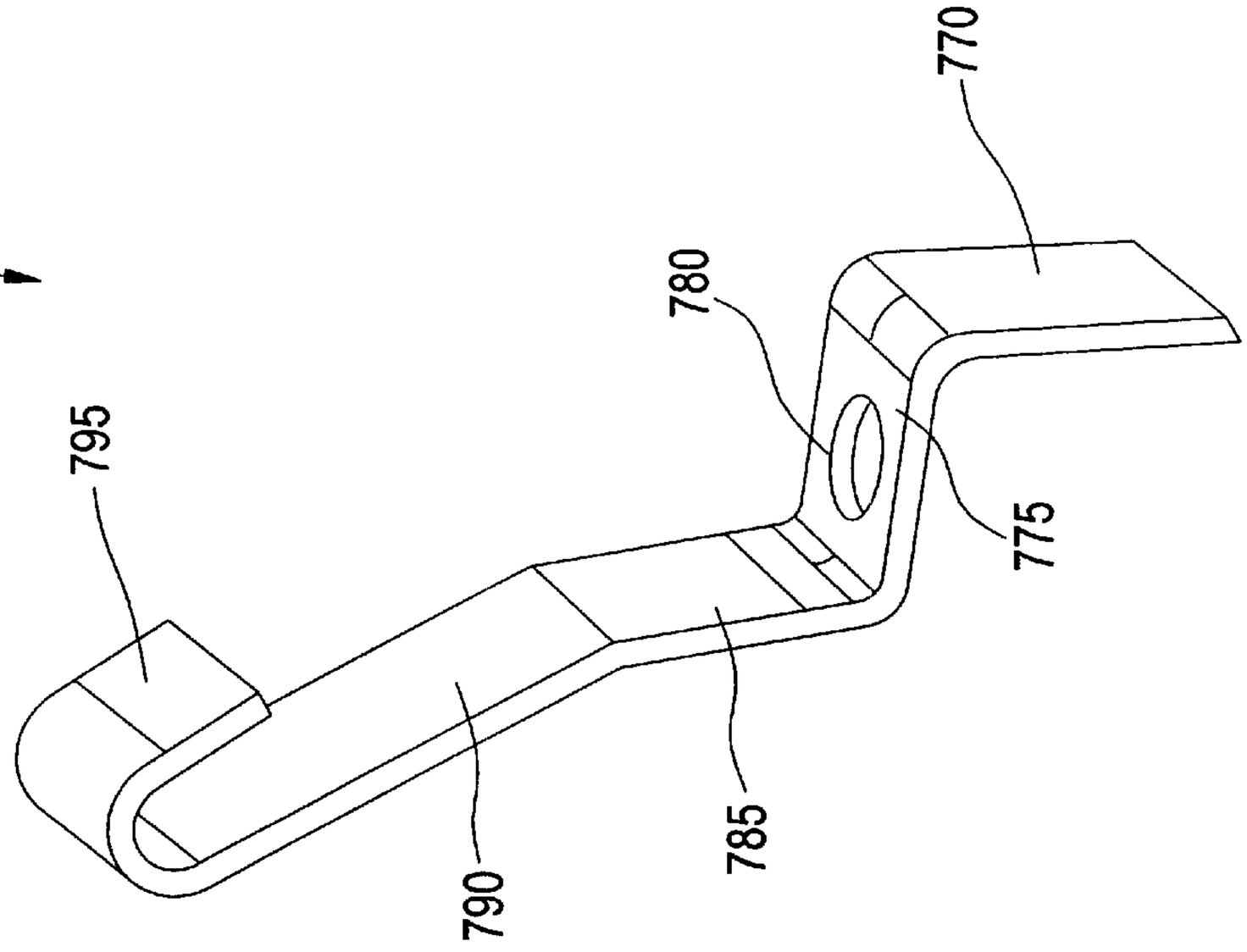
FIG. 24



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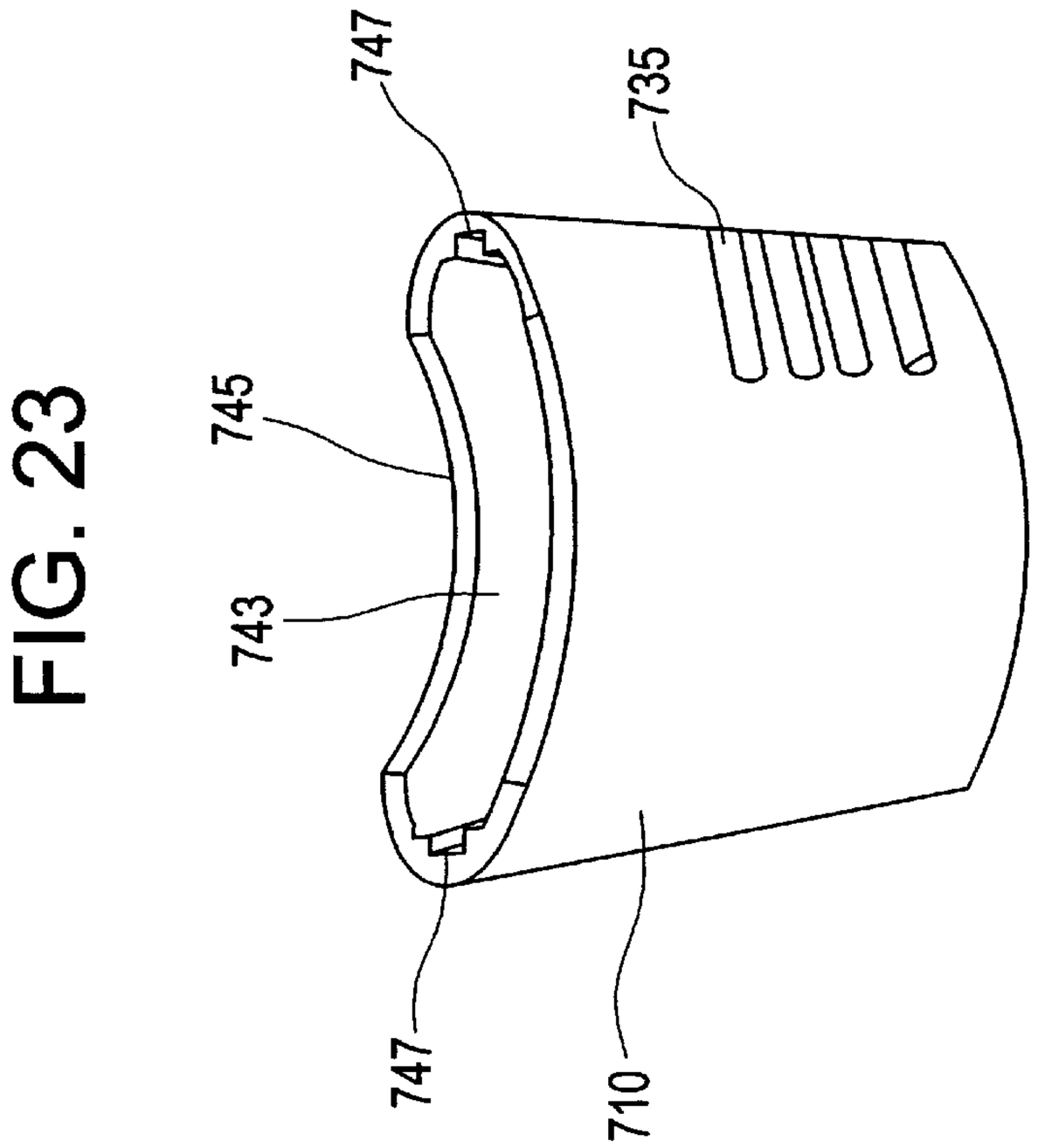

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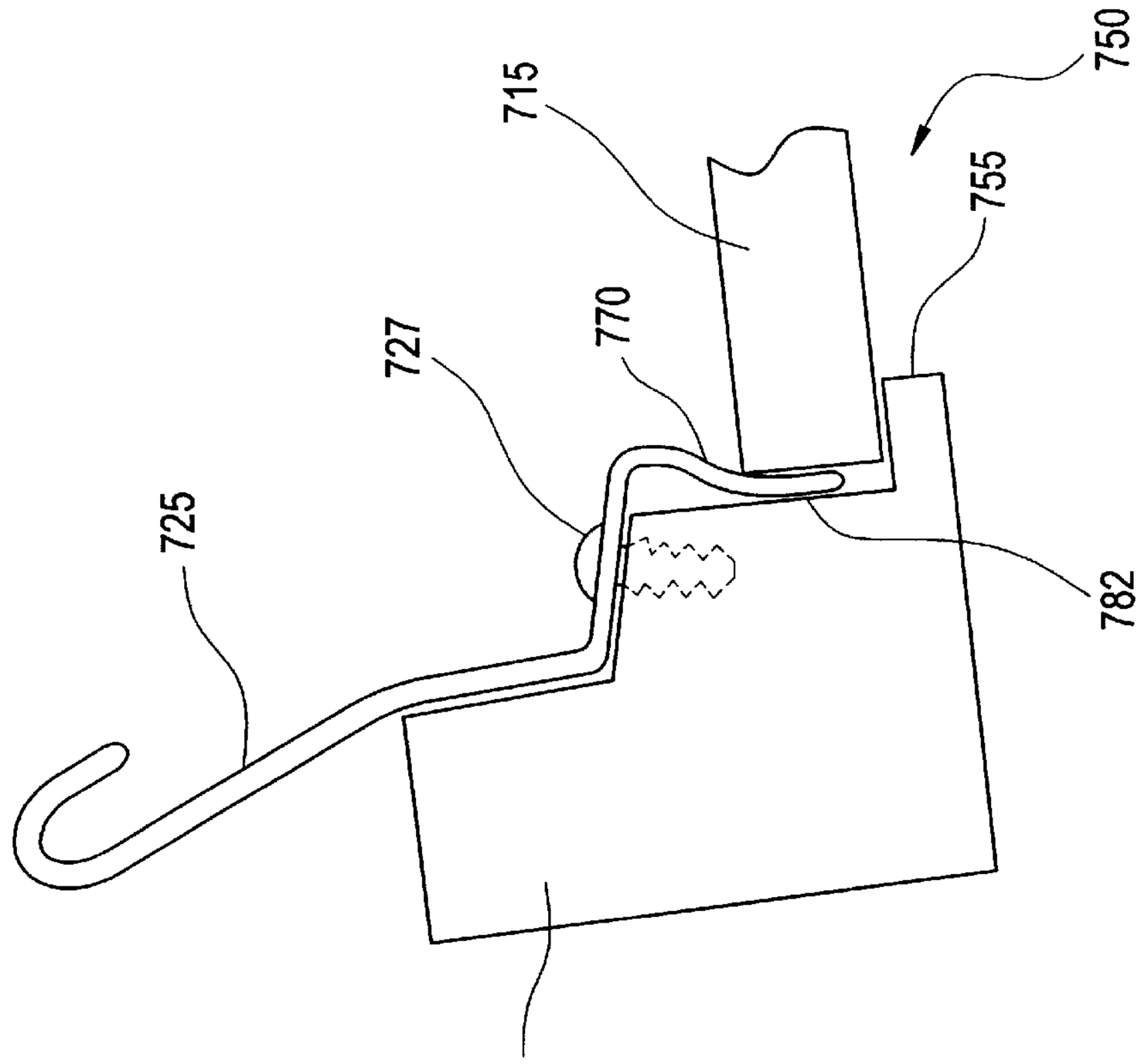
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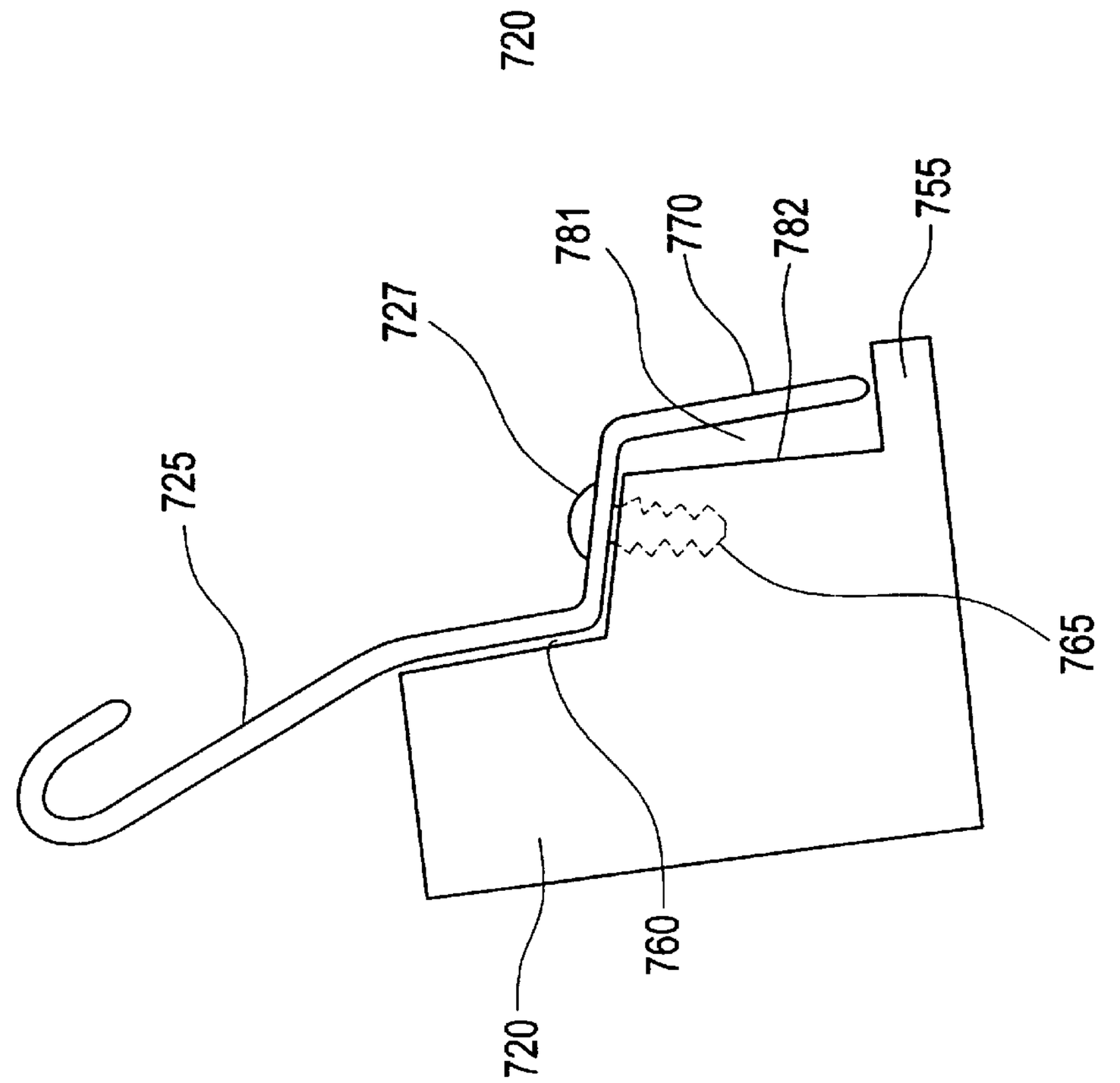
FIG. 25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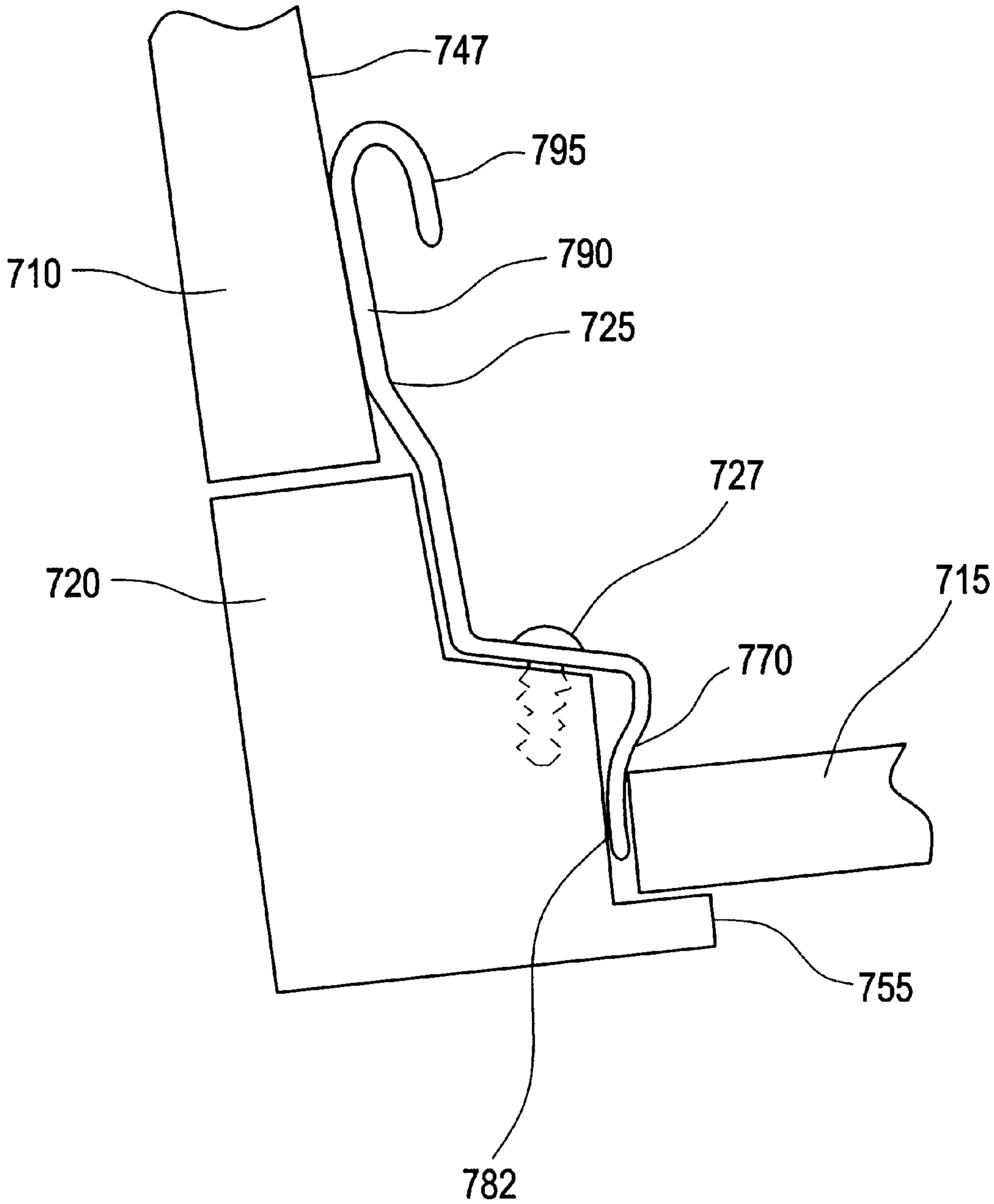

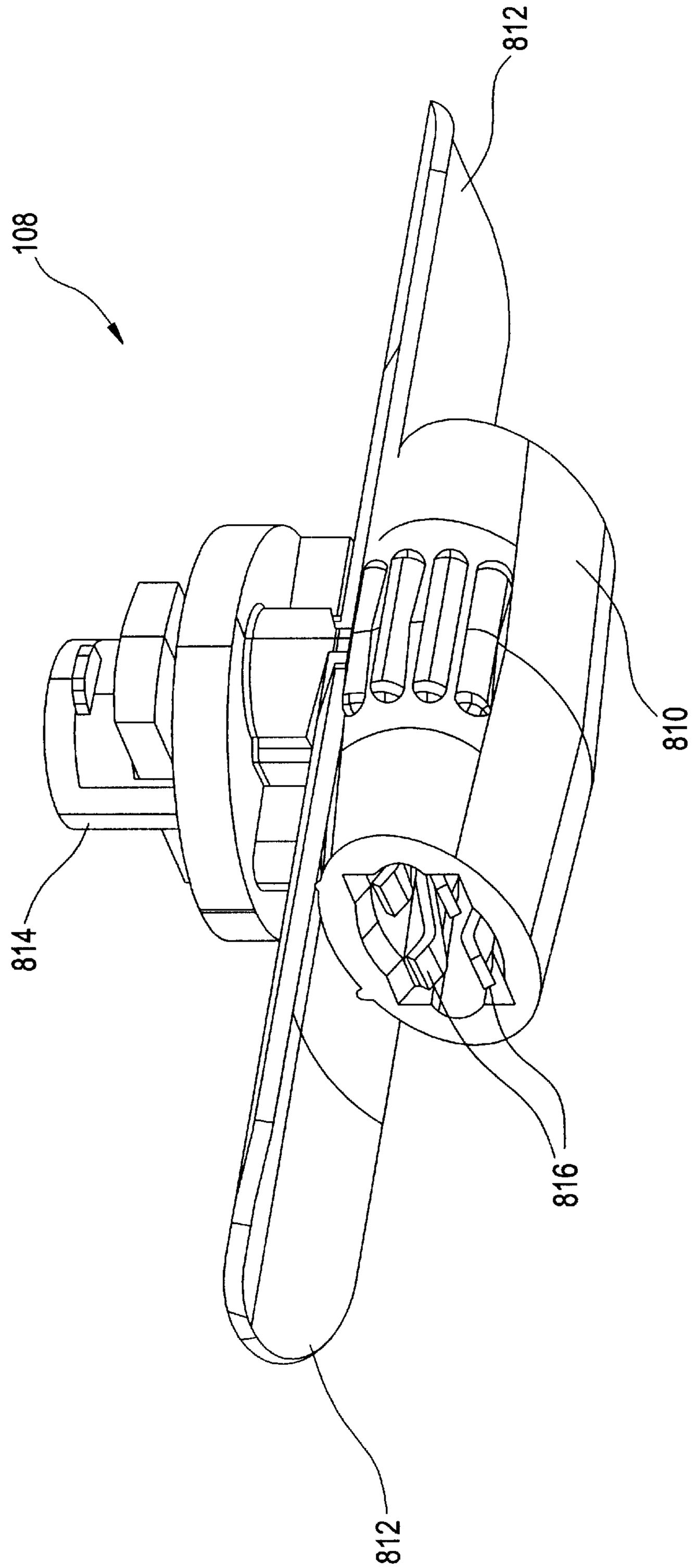

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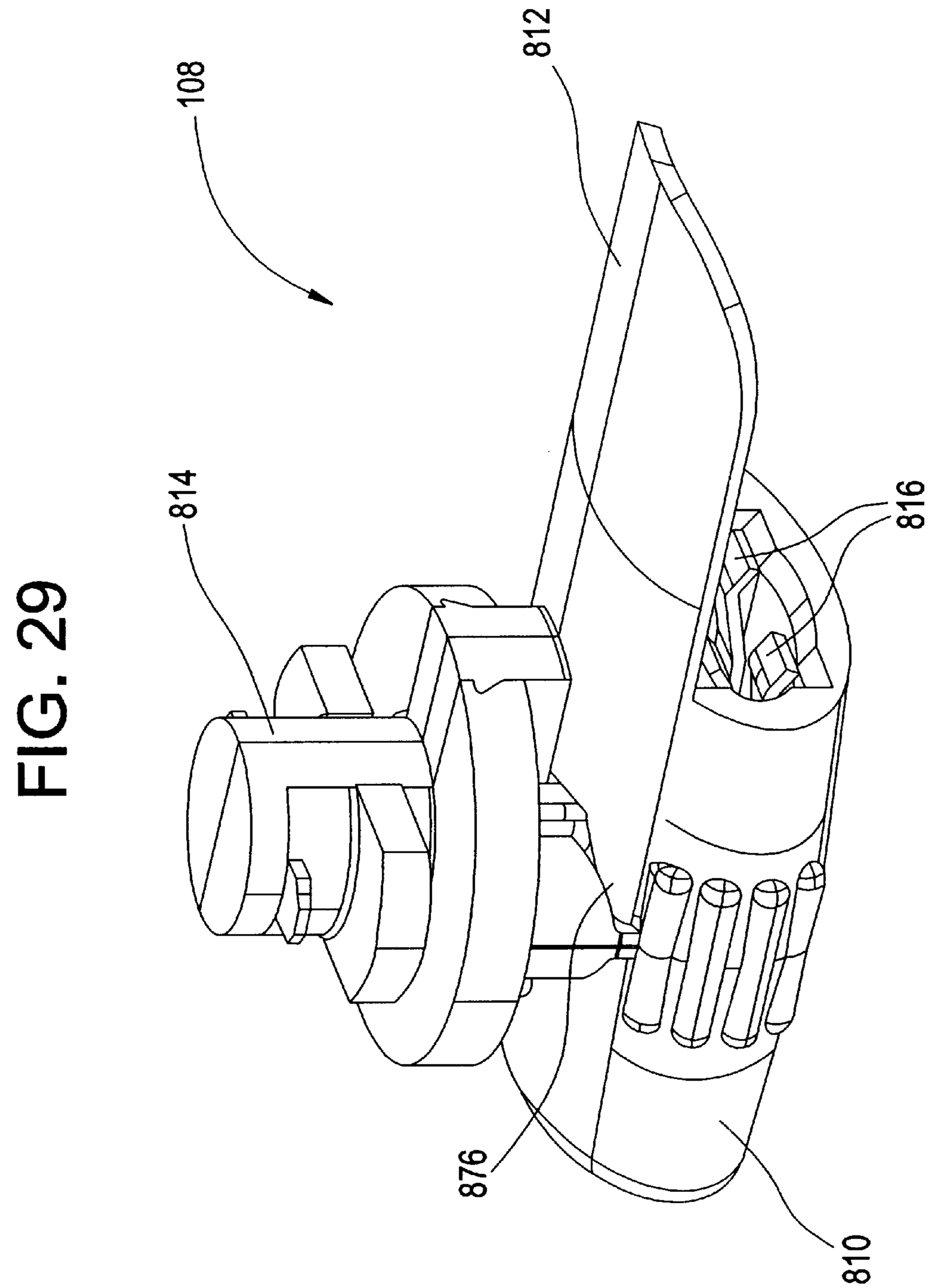

FIG. 29

FIG. 30

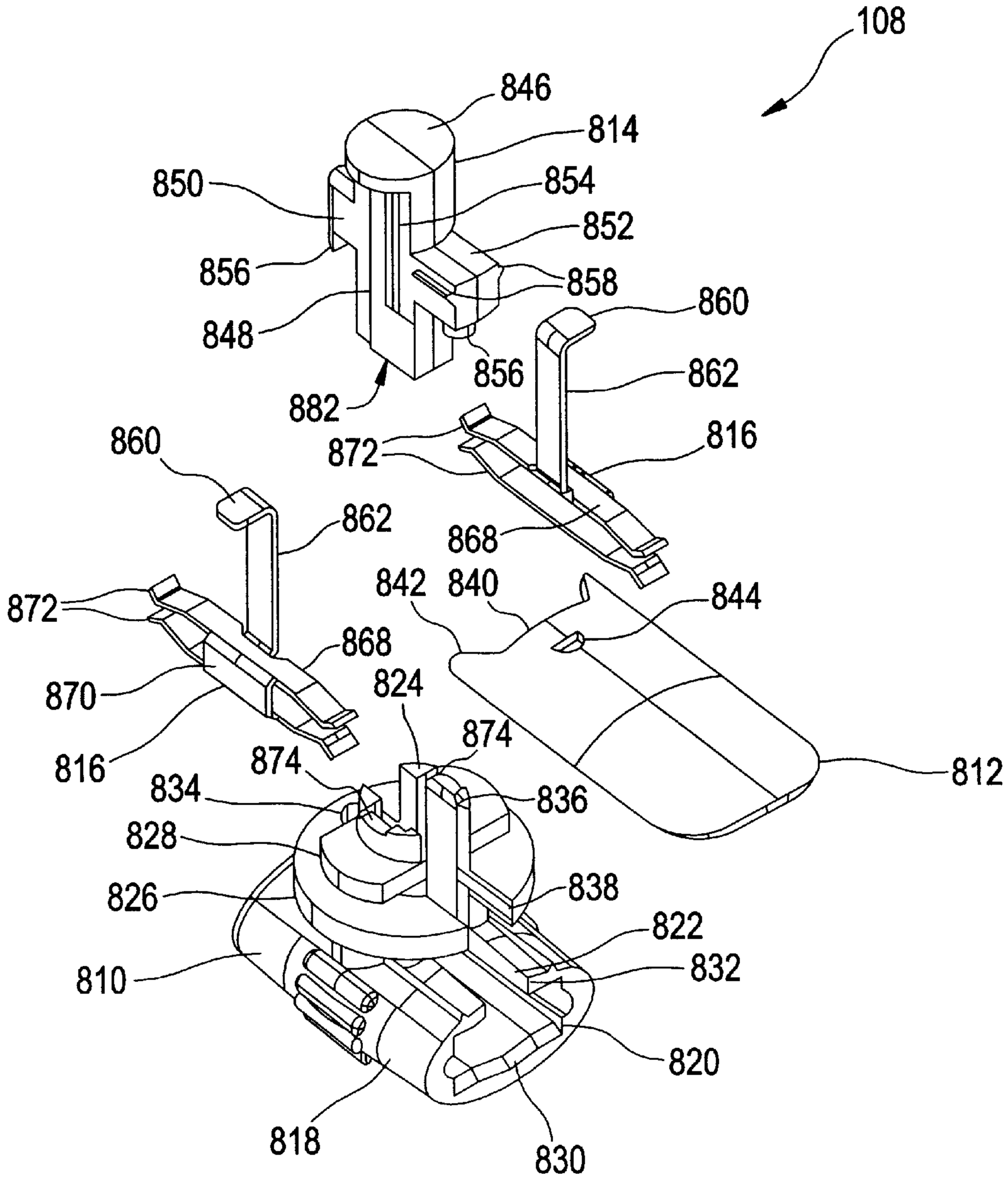
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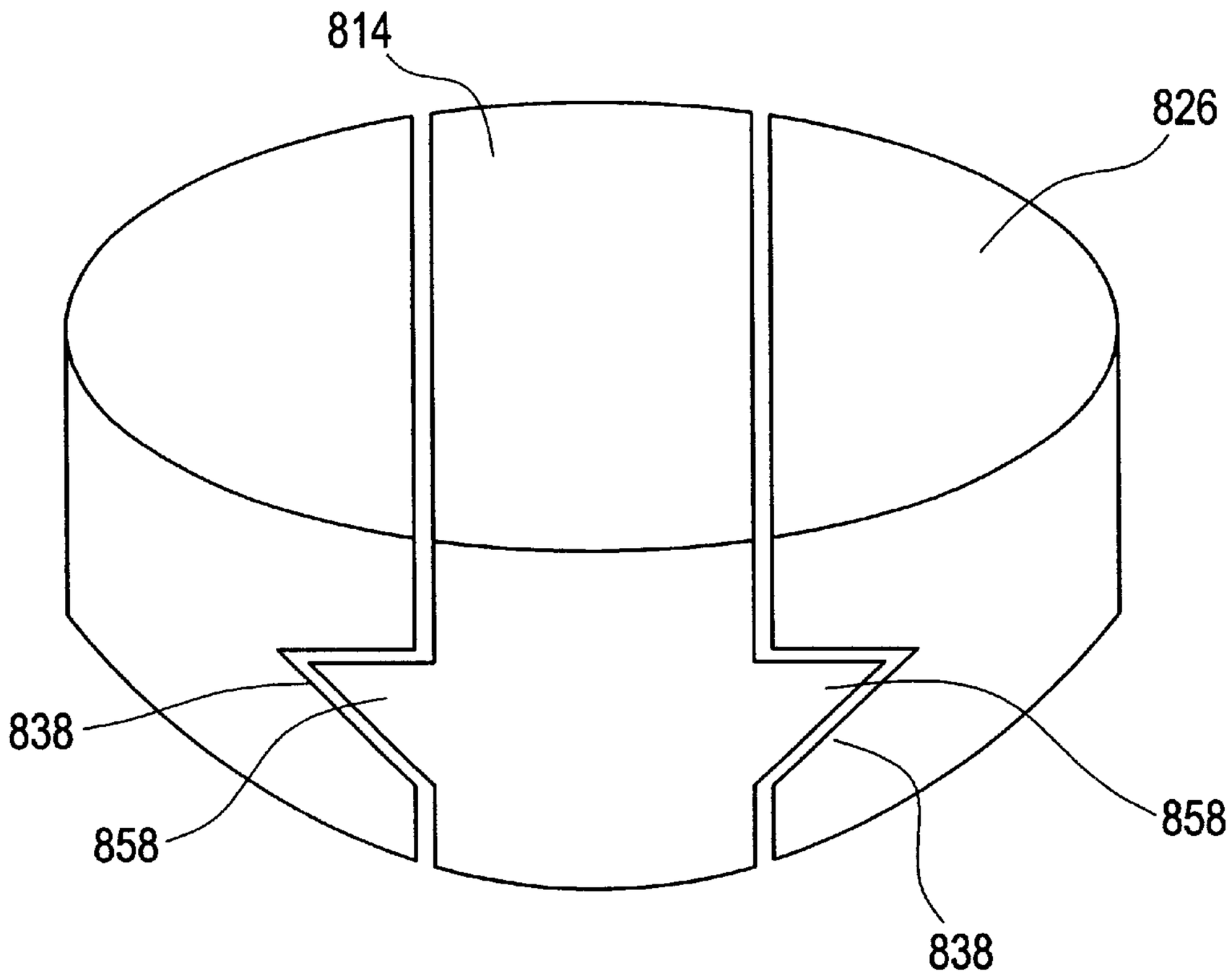
FIG. 31



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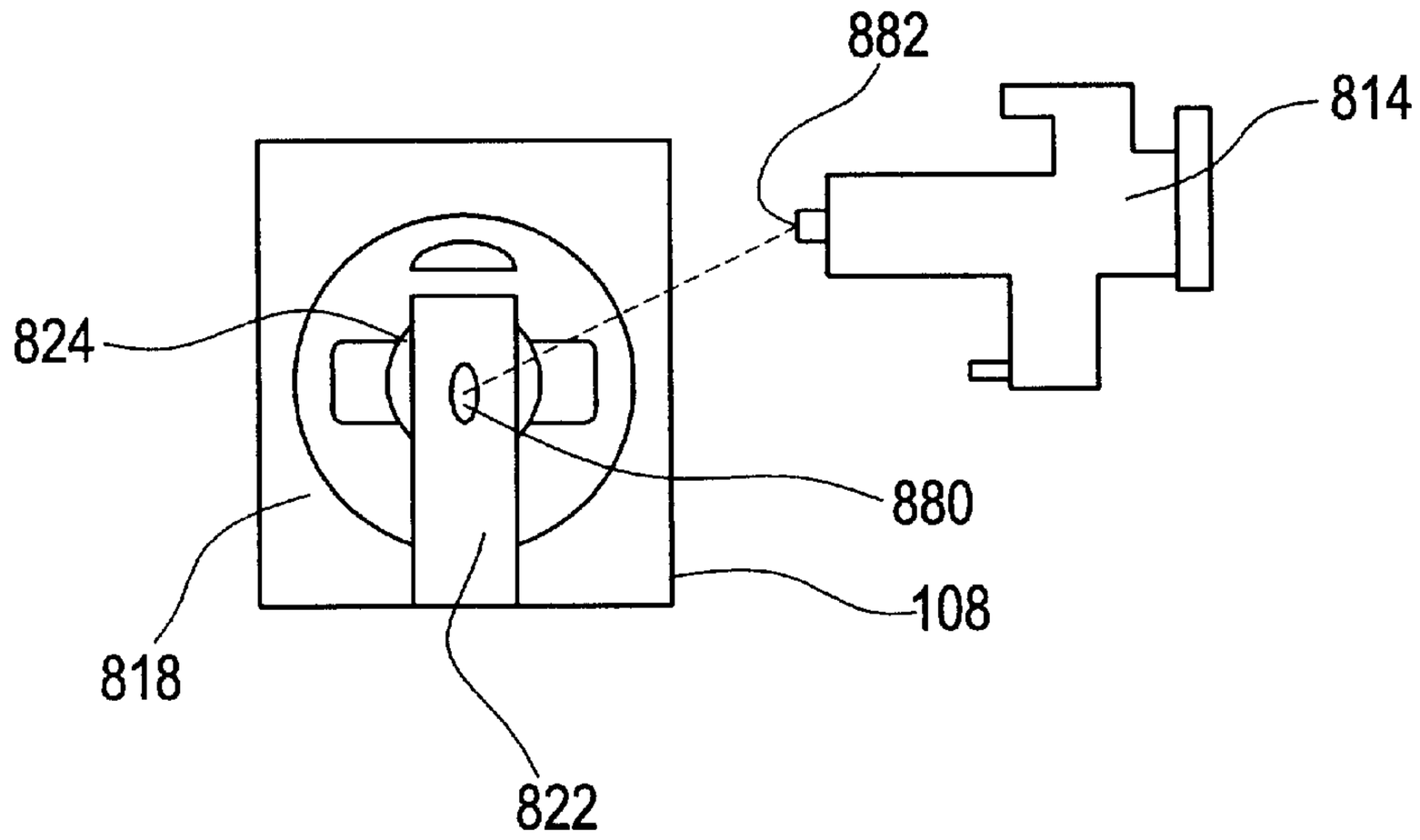

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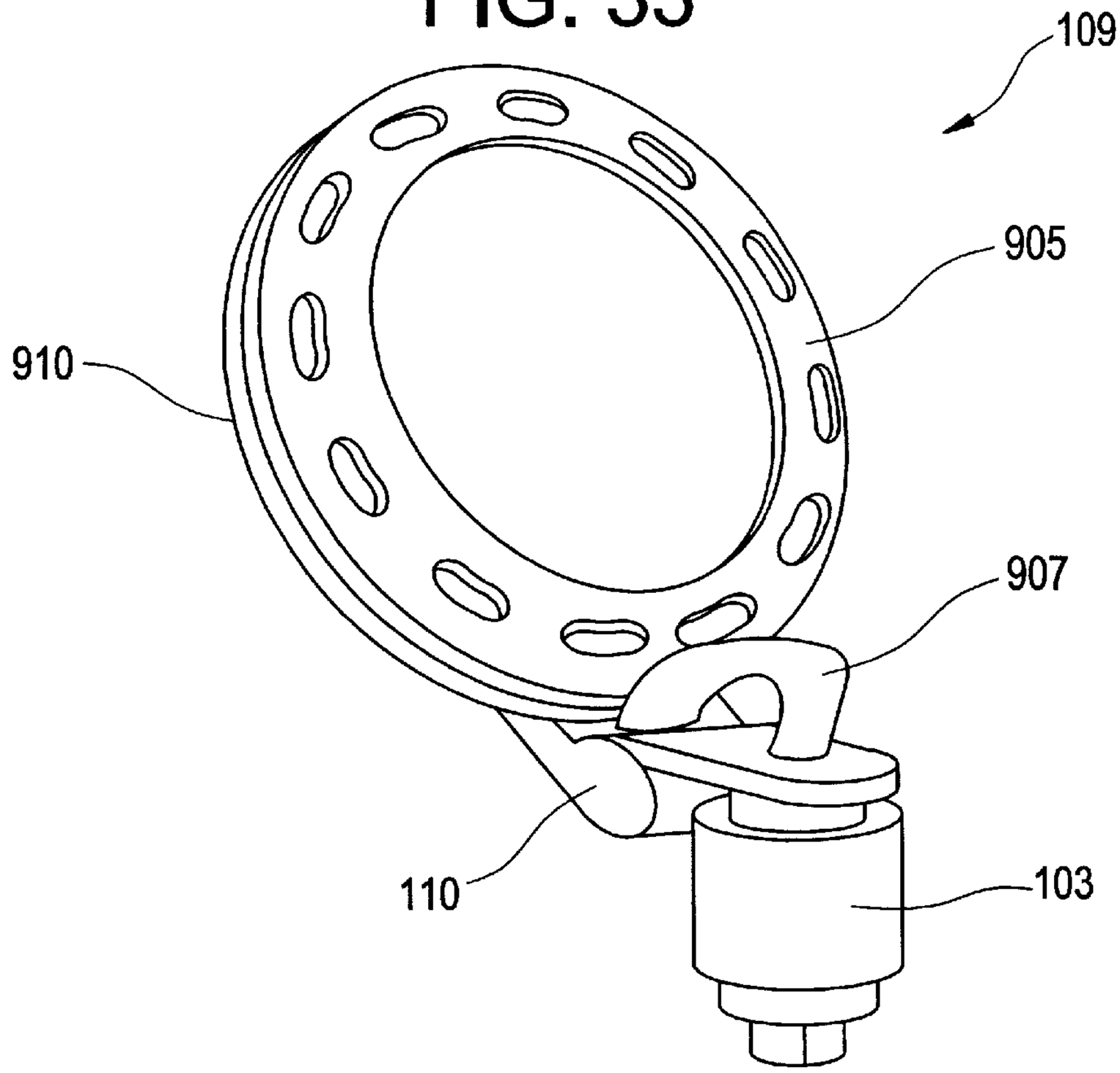
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FIG. 37

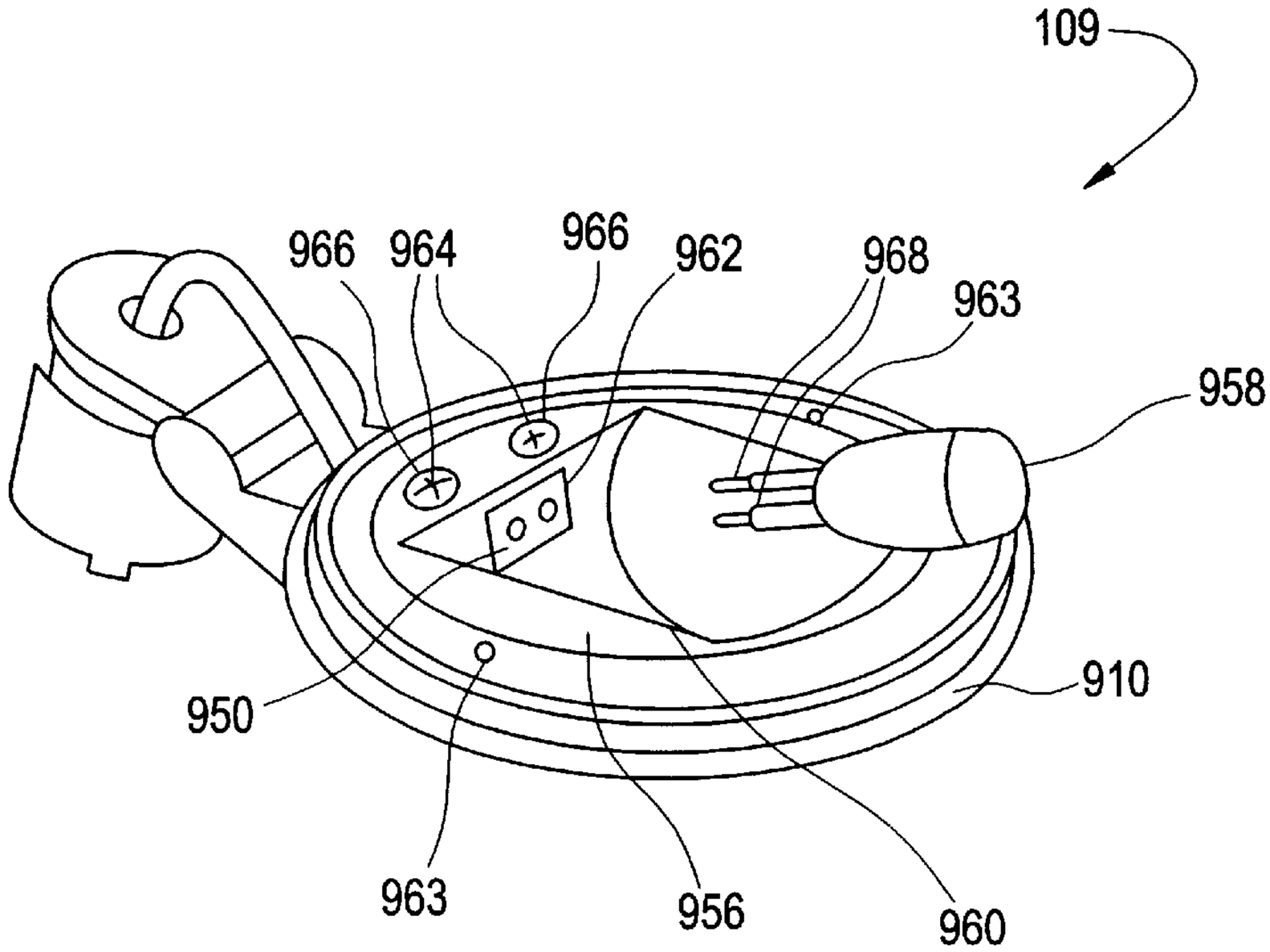
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FIG. 34

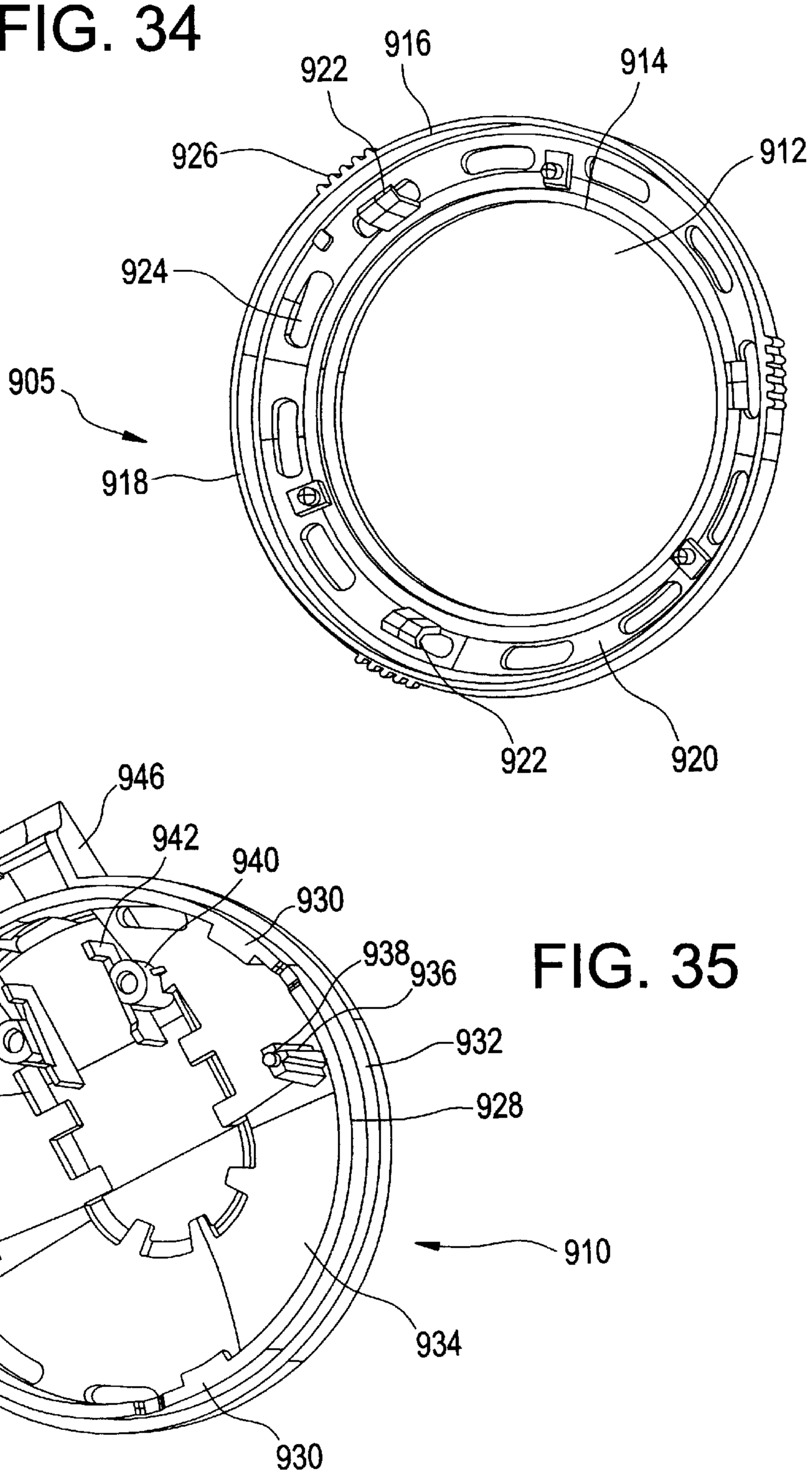
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FIG. 35

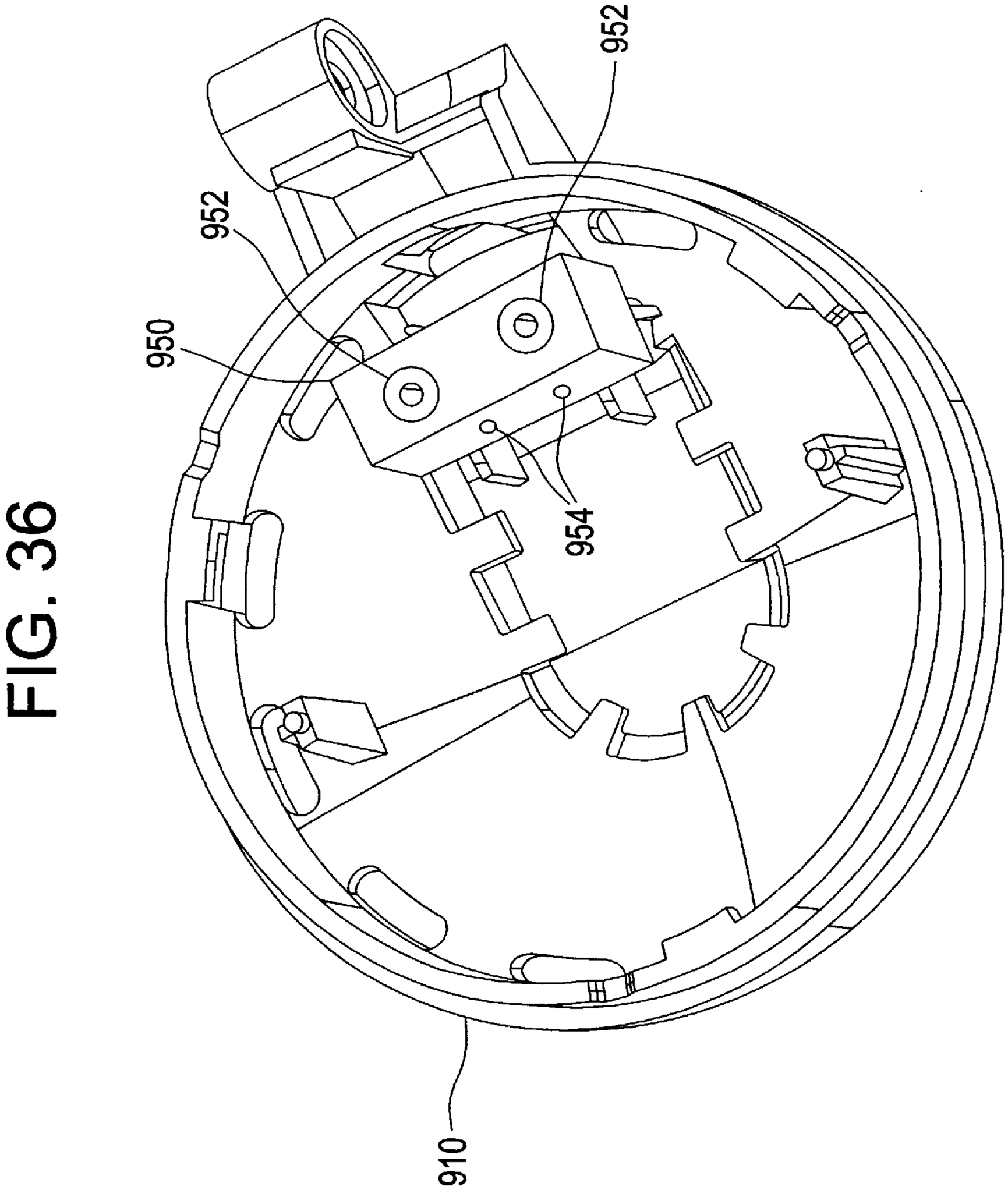
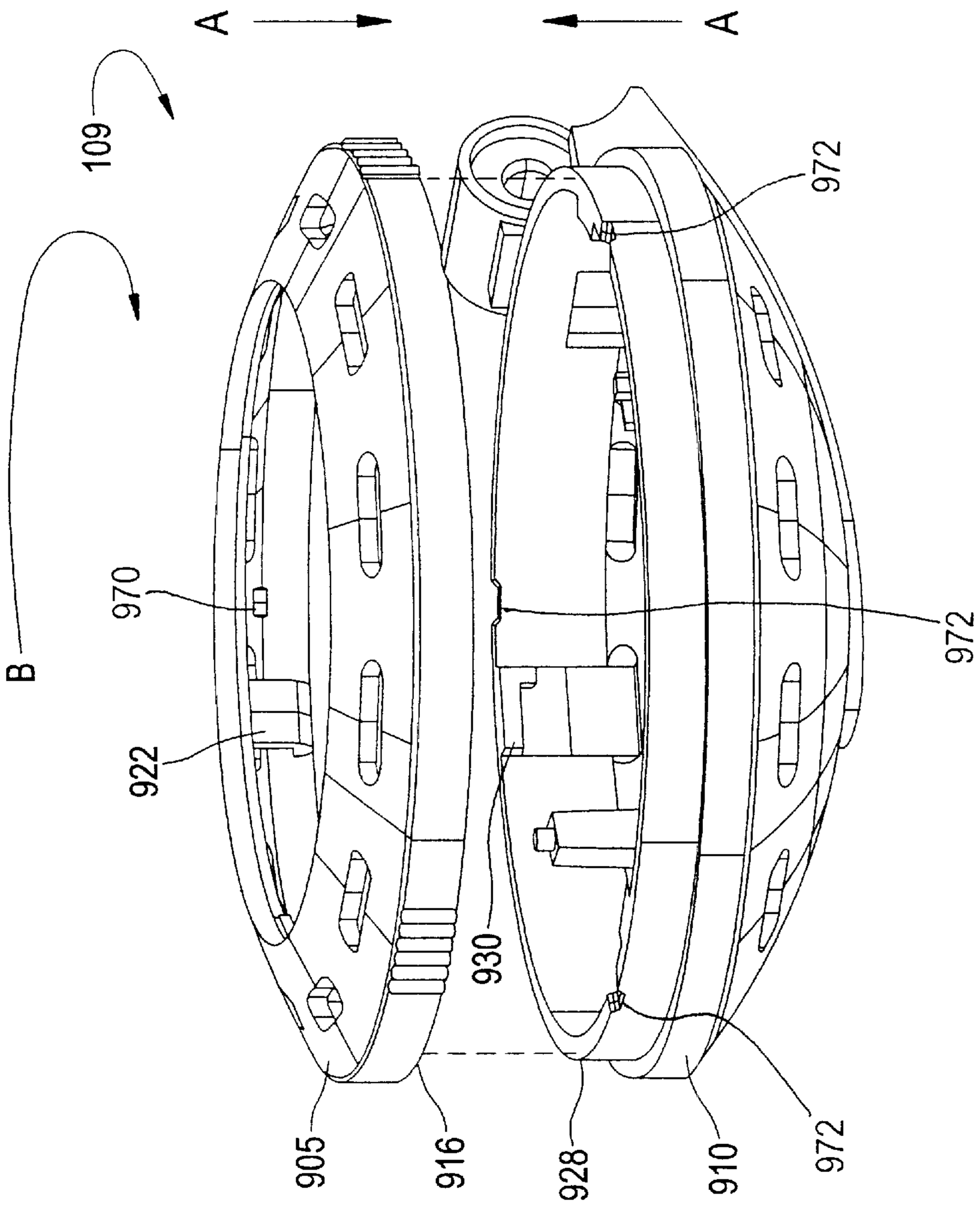


FIG. 36

FIG. 38



HOUSING ROTATION LOCK FOR A TRACK LIGHTING FIXTURE

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Application No. 60/221,563, filed Jul. 28, 2000; U.S. Provisional Application No. 60/221,564, filed Jul. 28, 2000; U.S. Provisional Application No. 60/221,565, filed Jul. 28, 2000; U.S. Provisional Application No. 60/221,567, filed Jul. 28, 2000; U.S. Provisional Application No. 60/221,568, filed Jul. 28, 2000; U.S. Provisional Application No. 60/221,569, filed Jul. 28, 2000; and U.S. Provisional Application No. 60/221,570, filed Jul. 28, 2000, all of which are incorporated by reference.

TECHNICAL FIELD

This invention relates to track lighting systems and more particularly to a housing rotation lock.

BACKGROUND

Track lighting systems allow installation of light fixtures using a single set of track conductors. Track lighting systems can provide light over a wide area and can be used to accentuate specific objects within a room. Thus, track lighting systems are widely used both in private residences as well as in publicly accessible buildings, such as commercial establishments and museums.

Track lighting systems come in a variety of shapes, sizes, and configurations. More commonly, the track frame is configured as an elongated rectangle or strip. Track lighting systems typically include spot light fixtures that are inserted along the narrow, electrified track frame. One side of the track frame mounts to a ceiling or wall and the side opposite the mounting surface usually has an opening along the length of the track frame for inserting light fixtures. The component of the light fixture that inserts into the track usually provides both an electrical connection with the track conductors and a mechanical connection to secure the fixture.

SUMMARY

In one general aspect, a track lighting fixture includes a first housing half and a second housing half. The first housing half includes a surface, an inner perimeter, a recess in the surface, and mating ramps extending from the inner perimeter. The second housing half includes a surface, a protrusion extending from the surface, and mating arms extending from the surface.

In other implementations, the track lighting fixture may include one or more of the following features. For example, the protrusion may be configured to fit within the recess and each mating arm may be configured to mate with a corresponding mating ramp when the first housing half is mated to the second housing half.

The mating ramp may include a first segment that is generally parallel to the inner perimeter and a second segment extending from the first segment and configured to stop the movement of the mating arm when the mating arm is mated with the mating ramp. Each mating arm may have a first segment extending from the surface of the second housing and a second segment extending from the first segment. A surface of the first segment of the mating ramp may be adjacent to a surface of the second segment of the mating arm when the first housing half is mated to the second housing half.

Mating of the mating arm with the mating ramp may occur by a friction fit mating. The fitting of the protrusion within the recess may cause a positive lock between the first housing half and the second housing half.

The first housing half and the second housing half may be configured to be mated by rotational movement of the first housing half relative to the second housing half, which may include a non-engagement movement portion between the mating ramp and the mating arm and an engaged movement portion between the mating ramp and the mating arm. The non-engagement movement portion may include the protrusion in contact with the surface of the first housing half. The engaged movement portion may include the protrusion being in contact with the surface of the first housing half and the second segment of the mating arm being engaged with the first segment of the mating ramp. In this manner, the contact between the surface of the first housing half and the protrusion causes the engagement of the second segment of the mating arm with the first segment of the mating ramp to be under compression. The rotational movement of the first housing half relative to the second housing half may further include a non-engaged portion that is between the mating ramp and the mating arm with the protrusion being loosely within the recess and a loose engagement of the second segment of the mating arm with the first segment of the mating ramp.

The first housing half or the second housing half may include a reflector and the other housing half may include prongs extending from the respective housing half such that the prongs are adjacent to an edge of the reflector when the first housing half is mated with the second housing half. The first housing half and the second housing half may include vent holes configured to vent heat generated by operation of a lamp within the mated first housing shell and second housing shell. The vent holes in the housing halves may be aligned when the first housing shell is mated with the second housing shell.

In another general aspect, a method of mating the first housing half to the second housing half of the lighting fixture described above includes placing the first housing half against the second housing half and rotating the first housing half relative to the second housing half until the protrusion is within the recess and the mating arm is mated with the mating ramp.

The track light system includes relatively few parts and is designed for easy and rapid assembly. The track lighting system provides a lower profile with aesthetically pleasing fixtures and components. Another version of the track light system provides a larger, more rigid track frame in applications where additional mechanical strength is necessary, such as, for example, suspended applications.

The track connector includes contact blocks that integrate the track frames by making both electrical and mechanical connections with the track conductors. The connections between the various components are securely fastened by compressive as well as penetrating forces. Thus, once the track light system is installed, the electrical connections and mechanical integrity are extremely reliable and require little or no maintenance. The track connectors also have a variety of shapes for flexibility in shape and construction of the track system on various surfaces.

The light fixture interface provides a low profile, quick connect/disconnect device for attaching the track light fixture to the track frame. Once installed, the interface provides a secure mechanical connection and a reliable electrical connection. The interface allows a track light fixture to be

removed or adjusted without fear of contact with the electrical conductors.

The track lighting system is designed to accommodate an array of different light fixtures that can produce a variety of lighting effects. For example, the wedge base track fixture and the rotation lock housing fixture have compact designs and a minimal number of parts, and are suitable for under-cabinet and task lighting applications. The rotation-lock housing fixture has the added benefit of a pivot mechanism that permits rotation of the light source for illumination of a specific area.

The light fixtures are designed for use with high intensity lamps. Low-voltage halogen light can be used for dramatic emphasis while protecting against fading and light damage. Many of the light fixtures are suitable for use as accent and spotlights as they can be adjusted or aimed by using a pivot mechanism and other aiming features. The pivot mechanism has components that are fastened together in a manner that prevents use and wear from causing the components to separate or become loose. The pivot mechanism also is durable, has aesthetic symmetry as a component of the light fixture, and is designed with a minimal number of parts.

The light fixture with integral constant tension and rotation stop is light-weight, easy to manufacture, has a minimal number of parts, and resists wear. The wear-resistant feature provides constant tension between the aiming arm and the lamp retaining ring to prevent looseness or laxity between these components. Thus, the lamp retaining ring is rotatable to a fixed position and will maintain that fixed position even after extended use.

The track light system is designed to accept high wattage loads at 24 volts so that the track network can be very long with a greater number of light fixtures -and lamp holders. Installed costs are lower in comparison to either 120-volt track systems with low-voltage lamp holders or to dedicated 12-volt track systems. The effects of voltage drops caused by line losses are reduced in 24-volt systems. Lamp and fixture current also are lower when operated at 24 volts, resulting in more reliable electrical connections. Lamp lumen output and color consistency also are more uniform. Although discussed with reference to low voltage applications, the concepts described herein for track light systems can be applied to other operating voltages as well, such as, for example, 124 volts or higher.

The track lamp fixtures and holders are miniaturized to perform their lighting tasks with a low profile system. Low-voltage halogen light can be used for dramatic emphasis while protecting against fading and light damage. Lamp holders also are designed with a reduced number of parts to reduce manufacturing costs.

The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features and advantages will be apparent from the description, the drawings, and the claims.

DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view of a track light system.

FIG. **2**A is a perspective view of a surface channel track network of the track light system of FIG. **1**.

FIG. **2**B is a perspective view of a wire way channel track network of the track light system of FIG. **1**.

FIG. **3** is an exploded perspective view of a track connector for use with the track network of FIG. **2**.

FIG. **4** is a bottom view of a mating wing usable with the track connector of FIG. **3**.

FIG. **5** is an exploded perspective view of a second track connector usable with the track light system of FIG. **1**.

FIG. **6** is a bottom view of a straight track connector usable with the surface channel track network of FIG. **2**A.

FIG. **7** is a perspective view of an angled track connector usable with the track network of FIGS. **2**A and **2**B.

FIG. **8** is a perspective view of a flexible track connector usable with the track network of FIGS. **2**A and **2**B.

FIGS. **9** and **10** are exploded perspective views of an interface for use with the track light system of FIG. **1**.

FIG. **11** is a bottom perspective view of the interface of FIGS. **9** and **10**.

FIGS. **12** and **13** are perspective views of a constant tension and rotation stop lamp holder.

FIGS. **14** and **15** are side views of the constant tension and rotation stop of FIG. **12**.

FIGS. **16** and **17** are side and perspective views of a lamp holder with a pivot mechanism.

FIGS. **18–21** are exploded perspective views of pivot mechanisms.

FIG. **22** is an exploded perspective view of a lamp holder with an integral lens retention spring.

FIG. **23** is a perspective view of a housing for the lamp holder with an integral lens retention spring.

FIG. **24** is a perspective view of a lens mounting spring for the lamp holder with an integral lens retention spring.

FIGS. **25–27** are cut-away views of the lens mounting spring and the housing.

FIGS. **28–30** are perspective and exploded views of wedge base lamp holders.

FIG. **31** shows a top-portion of a retention plug inserted in a stop disk for the wedge base lamp holder.

FIG. **32** shows a retention plug and holder for the wedge base lamp holder.

FIG. **33** is a perspective view of a rotation lock housing fixture.

FIGS. **34–37** are perspective views of front and rear housings for the rotation lock light fixture.

FIG. **38** illustrates assembly of the rotation lock light fixture lamp holder with an integral lens retention spring.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

Referring to FIG. **1**, a track light system **100** includes a track network **101**, a connector **102**, interfaces **103**, a lamp holder **104** with a constant tension lamp arm with integral rotation stop, a lamp holder **105** with a pivot mechanism **106**, a lamp holder **107** with integral lens retention spring, a wedge-base lamp holder. **108**, a rotation lock light fixture **109** with a pivot mechanism **110**, and a feed **111**.

The track light system **100** may be operated at various voltages. For example, the track light system may be operated at 24 volts and 25 amps (600 watts) or at 12 volts and 25 amps (300 watts). Operating at these voltages, the track light system **100** does not require grounding. The track light system **100** may be operated with a variety of power supplies. For example, the track light system **100** may be operated with 60, 150, or 300 watt electronic power supplies, or with 150, 300, 600, or 1200 watt magnetic power supplies. Power supplies may be designed for operation at various input voltages, such as, for example, 120 volts or 277 volts, with alternating current feed.

Electronic power supplies are lightweight and relatively small, allowing their use in cabinets and confined areas. Power supplies are designed for tie-in to existing feed locations and can be placed at the start of the track network **101** or at any point along the track network **101**.

Magnetic power supplies, though larger and heavier, can handle larger loads. These power supplies are available for 120 volt or 277 volt feeds. The wiring used to connect the magnetic power supply to the track network **101** can affect the load carrying capability of the track light system **100**. Boost taps can be used to increase the rated power capability of the track light system **100**.

Referring also to FIG. **2**A, the track network **101** includes a track frame **112** with an opening **113**, a lower channel **115**, and an upper channel **120**. The upper channel **120** includes a pair of conductors **125**. An open slot **130** extends from the lower channel **115** into the upper channel **120**. The interface **103** (described below with respect to FIG. **9**) is designed for insertion through the opening **113** with portions of the interface **103** secured in the lower channel **115** and the upper channel **120** so as to make an electrical connection with the conductors **125** within the track network **101**.

The track network **101** comes in various lengths. For example, the track network **101** may come in 2, 4, 6, or 8 foot lengths. Track networks **101** also may be cut to any particular length. Track networks **101** may have different finishes, such as, for example, white, black or silver-metallic finishes.

In the implementation of FIG. **2**A, the track network **101** is configured to be a surface channel track network with minimal size and weight. For example, the. surface channel track network may be ⅜ inches high and ¾ inches wide. The surface channel track network may be made from thermoplastic materials. The flexibility of these materials allows the track network **101** to be bent to conform to a non-linear surface. Typical applications for such a track network **101** are under-cabinet, in-cabinet, cove, and strip lighting.

In another implementation, illustrated in FIG. **2**B, the track network **101** is configured to be a wire way track network with more size and weight. For example, the wire way channel track network may be one inch high and one inch wide. The wire way channel track network may be made from materials with additional strength, such as, for example, extruded aluminum. Typical applications for this type of track network **101** are where additional mechanical strength is desired, such as, for example, suspended applications and accent or display lighting. Wire way track networks may be mounted directly to a surface or suspended. The wire way track networks also differ from the surface channel track networks because of the relatively larger size of the lower channel **115** of the wire way track network, which is sized to accommodate conductors **125** or wires to provide power to another part of the track light system.

The wire way track network accommodates conductors **125** that are insulated from the metal track frame **112** by insulation **135**. Stranded wire, as well as conductors, also may be housed in the track frame **112**.

The conductors **125** are made of conductive metal materials, such as, for example, copper, nickel-plated copper, or nickel-plated brass. The conductors **125** may have various sizes, such as, for example, 10, 12, or 14 AWG.

Referring to FIG. **3**, the feed **111** includes a housing **202**, a housing screw **204**, a mounting portion **205**, and a body **206**. The mounting portion **205** is used to mount the housing **202** to a ceiling or a wall and includes channels **207** for inserting a screw or nail. The body **206** includes a mating wing **208** with lips **210**, a mating screw **212**, a housing screw hole **214**, channels **216**, and slots **218**.

Contact blocks **220** are positioned in the channels **216**, which extend through the body **206**. Each contact block **220** includes an opening **222** that extends through the contact block **220** in the same direction as the channel **216**.

The contact blocks **220** (FIG. **3**) and **262** (FIG. **5**) may be made of materials such as are described in FIG. **2** above with respect to track conductors **125**. A contact retainer **224** partially wraps around the body **206** with a head **226** of the contact retainer **224** inserted into a notch **228** in the slot **218** and a foot **230** of the contact retainer **224** inserted inside the opening **222** of the contact block **220**. The foot **230** on the contact retainer **224** is configured to act as a stop for track conductors **125** that are inserted into the opening **222**.

The contact block **220** has a threaded rear hole **234** and a threaded front hole **236** through a top surface **238** of the contact block **220**. A rear retaining screw **240** and a front retaining screw **242** are configured to be threadably inserted into the threaded holes **234**, **236** and into the openings **222**. The rear retaining screw **240** is threaded into the threaded opening through the slot **218** to fix the foot **230** of the contact retainer to the contact block **220**. The head of the retaining screw **240** contacts an edge of the slot **218** to fix the contact block **220** inside the channel **216**.

To electrically connect electrical wiring from, for example, a junction box or transformer, and a track network **101** to the feed **111**, the rear retaining screw **240** is loosened and one wire of the electrical wiring is inserted into the opening **222** until the wire rests against the contact retainer **224**. The rear retaining screw **240** then is tightened down into the opening **222** to hold that wire in place in the contact block **220**. The other wire from the electrical wiring is inserted into the other contact block **220** from the same direction and retained in the contact block **220** in the same manner. Then, one conductor **125** from one track network **101** is inserted into the opening **222** from the other direction until the conductor rests against the contact retainer **224**. The front retaining screw **242** then is tightened down into the opening **222** to hold that conductor **125** in place in the contact block **220**. The other conductor **125** from the track network **101** is inserted into the other contact block **220** and retained in the contact block **220** in the same manner. The housing or cover **202** then may be mounted over the body **206**.

Referring to FIG. **4**, the connector **102** has many of the features of the feed **111** and also may include a housing **245** and a removable mating wing **250** with features similar to those of the mating wing **208**, including lips **210** and a mating screw **212**. The removable mating wing **250** is slidably connected to the body **206** by flared insert tabs **252** that mate with a recess **254** in the body **206**. Because the removable mating wing **250** is oriented in the opposite direction as the other wing of the body **206**, track network **101** can be mounted to both sides of the connector **102** to connect to track networks and extend the track light system **100**. The conductors **125** of each track network **101** are inserted into the openings **222** of the contact block **220** in the same manner described above with respect to FIG. **3**.

Referring to FIG. **5**, an end-feed, dual connector **260** holds a pair of dual opening contact blocks **262**. Each contact block **262** includes a pair of dual openings **264**. The end-feed dual connector **260** has features similar to those of the feed connector **102** described with reference to FIG. **3**, including a housing **202**, a housing screw **204**, and a body

209. The body 209 includes a tongue 208 with wings 210 and a tongue screw 212. The body 209 also includes a housing screw hole 272 and channels 216.

The contact blocks 262 are configured to be inserted in the channels 216. In this implementation, however, the channels 216 are open at the top and are covered by a plate 266. The plate 266 has rear screw holes 268, front screw holes 270, and the housing screw hole 272. As in the feed connector 102, the contact blocks 262 have openings 264 extending through the contact blocks 262 in the same direction as the channels 216. The contact blocks 262 have dual threaded rear holes 234 and threaded front holes 236 extending from the top surface 238 into the openings 264.

Rear retaining screws 240 extend through the rear screw holes 268, into the rear holes 234, and into the openings 264. Similarly, the front retaining screws 242 extend through the front screw holes 270, into the front holes 236, and into the openings 264. The plate 266 is positioned over the body 209 and retained by clamp arms 274 that extend from the plate 266 into notches 276 in the body 209.

The body 209 also includes a knock-out 278. The knock-out 278 is removed to provide a knock-out hole 280 for electrical wiring (not shown). An aperture 282 in the body 209 also can be used for electrical wiring (not shown). The wiring then is inserted into the openings 264 and the rear screws 240 are tightened down to fix the wiring to the contact block 262.

A variety of configurations for a feed connector may be employed. For example, the end-feed dual connector 260 as shown in FIG. 5 may be configured as a straight joiner connector for the wire way channel. Referring to FIG. 6, a straight joiner connector 284 includes a body 211 with two sets of mating wings 208, channels 216 (shown in FIG. 3), contact blocks 220 (shown in FIG. 3), and plates 266. Front retaining screws 242 and rear retaining screws 240 engage electrical wires 286 and other electrical components inserted in the openings 264 in the contact blocks 262 (FIG. 5).

Referring to FIG. 7, in another configuration, the feed connector is configured as a right-angle joiner connector 288. Referring to FIG. 8 the feed connector also can be configured as a flexible feed connector 290 that includes a flexible mid-section 292. The connectors 288 and 290 have features of the connectors 102, 245, and 260 such that electrical wires can be connected to the connectors 288, 290. Other implementations of connectors include J-box feed connectors for use in mounting to a single gang wall or ceiling-mount junction box, end-feed connectors for starting a run, and T-bar and J-box canopy feed connectors for starting a run on a T-bar ceiling installation.

Referring to FIG. 9, a track fixture interface 103 includes a cap 302, contact clips 304, jackets 306, screws 308, a top 310, a housing 312, a pair of springs 314, a base 316, a collar 318 with a lip 319, and an electrical wire 320. The screws 308 and the springs 314 are isolated from the contact clips 304 by plastic cylindrical walls 344 that are molded in place (FIG. 10). The cap 302 includes a head 326 and two arms 328 that terminate in flared hooks 329. The cap 302 is retained in place by a one-way latching mechanism that provides advantages over other retention means, such as a screw or a rivet, because the cap is easily inserted in place and does not require additional components. Each contact clip 304 includes a contact head 330 and a foot 332. The top 310 includes a notch 333, insert wings 334, a pair of screw holes 336, and a channel 338. The base 316 includes posts 340 and an aperture 342.

Referring also to FIG. 10, the springs 314 fit over the posts 340 on the base 316 and inside the pair of molded cylinders 344 in the housing 312. In this manner, the base 316 is slidable within the housing 312, with the spring 314 resisting insertion of the base 316 within the housing 312. The stiffness of the springs 314 can be adjusted to vary the resistance caused by the springs.

Referring also to FIG. 11, the foot 332 of each contact clip 304 is inserted through the channel 338. The arms 328 of the cap 302 then are inserted into the channel 338 until the head 326 is flush with the notch 333 above the insert wings 334. In this position, the hooks 329 extend through the channel 338 and expand outward into ledges 346 at the end of the channel 338, to lock the cap 302 in place.

Referring again to FIG. 9, the collar 318 is placed inside the base 316 with the lip 319 directed upward toward the cap 302. The collar 318 is allowed to slide through the aperture 342 in the base 316 until the lip 319 contacts the inside surface of the base 316 surrounding the aperture. The electrical wire 320 is inserted through the collar 318 and extends through the aperture 342 in the base 316 and housing 312. Conductors in the electrical wire 320 then are spliced and connected to the feet 332 of the contact clips 304 by placing each jacket 306 over the conductor and the foot 332 of the contact clip 304, and tightly crimping the jacket 306.

The interface 103 provides an electrical and mechanical connection between the track network 101 and a track light fixture. Installing the interface 103 into the track network 101 includes inserting the interface 103 into the opening 113 with the insert wings 334 extending through the slot 130 of the track frame 112 with the contact head 330 of the contact clip 304 in the lower channel 120 and the insert wings 334 in the upper channel 115. The interface 103 is rotated approximately 90 degrees relative to the track frame 110, which tightly wedges the insert wings 334 into the upper channel 115 and causes the contact head 330 of the contact clip 304 to make an electrical connection with the track network conductor 125. The springs 314 force the housing 312 against the track network 101 with tabs or rotation stops 348 on the housing 312 inserted into the opening 113 in the track frame 110. The insert wing 334 and rotation stops 348 prevent accidental separation or dislodgment of the interface 103 from the track network. The interface 103 provides advantages, such as being configured from fewer parts than conventional connectors or interfaces. Moreover, the interface 103 is advantageously smaller than conventional connectors or interfaces.

Referring to FIGS. 12 and 13, a constant tension and rotation stop light fixture 104 includes a lamp retaining ring 405, a lamp retaining arm 410, and an aiming arm 415. The lamp retaining arm 410 is attached to the aiming arm 415 with a rivet 420 and includes a pair of resilient fingers 425. The aiming arm 415 includes a base 430 that includes an opening 435 and a stop 440. The lamp retaining ring 405 includes a body 445 that has a perpendicularly directed lip 450.

FIG. 13 shows a light bulb 453 installed in the adjustable lamp arm 104 of FIG. 12. The light bulb 453 is positioned between the lip 450 and the fingers 425, with the front of the light bulb facing the lip 450. The pair of resilient fingers 425 exert pressure against the light bulb 453 to hold it against the lip 450.

The opposing end of the lamp retaining arm 410 includes a foot 455 with sloped sides 460. The foot 455 extends through a slot 465 in the lamp retaining ring 405. As the lamp retaining ring 405 and lamp retaining arm 410 are rotated in a circle around the axis of the rivet 420, the sloped

sides **460** of the foot **455** come into contact with the aiming arm **415**, which blocks further rotational motion in the same direction. Thus, the foot **455** acts as a rotation stop.

The lamp retaining ring **405** and the lamp retaining arm **410** are mounted to the aiming arm **415** using the rivet **420** around which the lamp retaining ring **405** and lamp retaining arm **410** can pivot. Referring also to FIG. **14**, the rivet **420** includes a head **470**, a shank **475**, and a hollow **480**. The shank **475** of the rivet **420** is inserted through a hole **485** in the aiming arm **415**, an opening in a tension washer **490**, and a hole **495** in the retaining ring **405**.

Referring also to FIG. **15**, the rivet **420** is crimped to attach the. aiming arm **415** to the lamp retaining arm **410**, which causes the shank **475** in proximity to the hollow **480** to mushroom outward and flattens the shank **475** against the inside of the retaining ring **405**. Crimping the rivet **420** also applies a compressive force to the tension washer **490** to reduce the cross sectional thickness, which leaves the washer **490** under a compressive force that the washer **490** resists by pressing outwardly against the aiming arm **415**.

The aiming arm **415** may be rotated relative to the retaining ring **405** and will maintain a fixed position because of the tension that is exerted between the aiming arm **415** and the retaining ring **405** as the tension washer **490** attempts to expand to its normal shape. Thus, rotational motion and other uses that would otherwise cause laxity or space between the aiming arm **415** and the retaining ring **405** are avoided by the constant expansive force from the tension washer **490**. In this manner, the tension washer **490** effectively allows the aiming arm **415** to be rotated to a desired, fixed position and to maintain that fixed position relative to the retaining ring **405**.

Referring to FIGS. **16** and **17**, a lamp holder **105** with the pivot mechanism **106** includes a lamp retaining ring **505**, a lamp retainer **510**, an extension arm **515**, a connecting arm **517**, a positioning handle **519**, and the pivot mechanism **106**. The connecting arm **517** and the lamp retainer **510** are mounted to the lamp retaining ring **505**. The lamp retainer **510** includes a pair of resilient fingers **525**. The extension arm **515** includes a base **530** that has an opening **535** and a stop **540**. The lamp retaining ring **505** has a perpendicularly directed lip **550** around part of the inner-circumference of the retaining ring **505**.

The extension arm **515** has a ribbed area **570** and the positioning handle **519** has a grip dome **580**. The grip dome **580** is made of rubber or other insulating material that does not easily conduct heat.

An electrical wire **585** connected to a light bulb **555** is inserted through the opening **535** and connected at the other end to the track fixture interface **103** described above with respect to FIGS. **9–11**. With the track fixture interface **103**, the lamp holder **105** can be moved along the track network **101** to provide illumination where desired.

Referring to FIGS. **18** and **19**, the pivot mechanism **106** includes a screw **610**, a bushing **615**, a compression washer **620**, a pivot holder **625**, a washer **630**, and an arm pivot **635**. The configuration of the pivot mechanism **106** is such that it prevents the screw **610** from backing out after repeated use. Thus, the pivot mechanism **106** also can be used in other applications that require a hinge with rotational motion that must not loosen over time and with repeated use.

The bushing **615** has a head **640** and a base **645**. The head **640** has a bevel **650** and a hole **655** that pass through the center of the head **640** and continue through the base **645**. The base **645** has two flat areas **660** at the end opposite the head **640**. The pivot holder **625** includes a circular lip **665** (FIG. **19**) with a smaller diameter than the outside surface of the pivot holder **625** extending around a portion of the pivot holder **625**. A circular opening **670** extends through the pivot holder **625**. The arm pivot **635** has a recess **675** that circles the inside diameter of the arm pivot **635** and a channel **680** extending about halfway into the arm pivot **635**. The channel **680** is circular with two flat sides **685**. The bottom of the channel **680** includes a threaded section **690** that extends deeper into the arm pivot **635** without penetrating the wall of the arm pivot **635**.

The pivot mechanism **106** is assembled by placing the washer **630** into the recess **675** of the arm pivot **635**. The pivot holder **625** then is placed against the arm pivot **635** such that the lip **665** extending from the pivot holder **625** fits within the inner diameter. of the washer **630**. The bushing **615** is inserted through the compression washer **620**, into the opening **670** in the pivot holder **625**, and then into the channel **680** in the arm pivot **635**. In this position, the flat areas **660** on the bushing **615** mate with the flat sides **685** in the channel to prevent rotation of the bushing **615** with respect to the arm pivot **635**. Next, the screw **610** is inserted into the hole **655** and is threaded into the threaded section **690** at the bottom of the channel **680** in the arm pivot **635** until the top of the screw **610** is flush with the top edge of the bevel **650**. The arm pivot **635** is connected to the extension arm **515**. The pivot holder **625** is connected to the connecting arm **517**.

Referring to FIGS. **20** and **21**, another implementation of a pivot mechanism **691** includes the screw **610**, the compression washer **620**, a base pivot **692**, and a lamp pivot **693**. The base pivot **692** includes the bevel **650**, the hole **655** that extends through the base pivot **692**, and a protruding rotation stop **694**. The end of the base pivot **692** nearest to the lamp pivot **693** includes the circular lip **665** (FIG. **21**) with a smaller diameter than the outside surface of the base pivot **692**. The base pivot **692** is connected to a base plate **695** with a hole **696**.

The lamp pivot **693** has a recess **675** (FIG. **20**) that circles the inside diameter of the lamp pivot and a threaded section **690** extending into the lamp pivot. The lamp pivot **693** also includes a protruding rotation stop **697**. The lamp pivot **693** is connected to a lamp housing **698**.

The pivot mechanism **691** is assembled by placing the compression washer **620** into the recess **675** of the lamp pivot **693**. The base pivot **692** then is placed against the lamp pivot **693** such that the lip **665** extending from the base pivot **692** fits within the recess **675**. Next, the screw **610** is inserted through the hole **655** and is threaded into the threaded section **690** in the lamp pivot **693** until the top of the screw **610** is flush with the top edge of the bevel **650**.

As shown in FIG. **22**, a lamp holder **107** with the integral lens retention spring includes a housing **710**, a lens **715**, a lens frame **720**, lens mounting springs **725**, and mounting screws **727**. The lens mounting springs **725** are mountable to the lens frame **720** and are configured to retain the lens **715** in the lens frame **720** and to attach the lens frame **720** to the housing **710**. The housing **710** includes a wiring hole **730**, fins **735**, a mounting platform **740**, and cut-out areas **745**. As illustrated in FIG. **23**, the housing **710** also includes a cavity **743** with recessed channels **747**. As described below, the recessed channels **747** are sized to receive the lens mounting springs **725** when the housing **710** is mounted to the lens frame **720**.

As shown in FIG. **22**, the lens frame **720** is a circular ring with a lens aperture **750**, retaining tabs **755** and a mounting notch **760** with a hole **765** in a wall of the lens frame **720**.

The lens **715** may be made of transparent or translucent materials, such as, for example, plastic or glass. Lens **715** may have a color filter and/or optical characteristics. For example, lens **715** may be a gel filter or dichroic filter in colors such as red, yellow, ultraviolet, amber, green, blue, or daylight. Optical filters may include diffuse, sandblasted, soft focus, prismatic spread, or linear spread lenses.

Referring to FIG. **24**, the lens mounting spring **725** includes a foot or first section **770**, a seat or second section **775** with a screw hole **780**, an elbow or third section **785**, a mounting arm or fourth section **790**, and a hook or curved section **795**. The second section **775** is generally perpendicular to the first section **770**. The third section **785** is generally perpendicular to the second section **775**. The fourth section **790** extends away at an angle from the third section **785**. The hook or curved section **795** is configured to ease and direct sliding of the mounting spring into the housing **710**. The lens mounting spring **725** attaches to the lens frame **720** by inserting the seat **775** of the lens mounting spring **725** into the mounting notch **760** in the lens frame **720**. The mounting screws **727** then are passed through the screw holes **780**. in the seat **775** and threaded into the hole **765** (FIG. **22**) to secure the lens mounting springs **725** to the lens frame **720**. The holes **765** can be threaded or non-threaded when, for example, the screws **777** are self-tapping.

FIG. **25** shows a cut-away view of the lens mounting spring **725** secured to the lens frame **720**. As shown, a gap **781** is formed between the foot **770** of the lens mounting spring **725** and a side wall **782** of the mounting notch **760**.

Referring to FIG. **26**, the lens **715** is pushed down into the lens frame **720** until the lens **715** contacts the retaining tabs **755** and causes the lower portion of the foot **770** to spring upward and back toward the side wall **782**. The lens **715** then is pushed away from the side wall **782** by the foot **770** and down into the lens aperture **750** until the lens **715** contacts the retaining tabs **755**. The retaining tabs **755** limit movement of the lens **715** in a first direction and the mounting springs **725** limit the movement of the lens **715** in a second direction. Thus, the lens **715** is fixed inside the lens frame **720** by the tension against the lens **715** by the foot **770**. Finally, referring to the cut-away view in FIG. **27**, the lens frame **720** is attached to the housing **710** by pushing the mounting arms **790** and hooks **795** into the recessed channels **747** in the cavity **743** of the housing **710**. Tension created by bowing in a portion of the mounting arms **790** against the recessed channels **747** fixes the lens frame **720** to the housing **710**.

Referring to FIGS. **28–31**, a wedge-base lamp holder **108** includes a holder **810**, one or two reflectors **812**, a retention plug **814**, and electrical contact clips **816**. For example, FIG. **28** illustrates the lamp holder **108** with two reflectors **812** and FIG. **29** illustrates the lamp holder with one reflector **812**.

Referring to FIG. **30**, the holder **810** includes a body **818**, a shaped channel **820**, an open channel **822**, a stem **824**, a stop disk **826**, and a rotation disk **828**. In the wedge base lamp holder **108** with one reflector **812**, the shaped channel **820** extends through one end **832** of the body **818**. The end of the shaped channel **820** has an angled ramp **830**. The open channel **822** extends from the open end **832** to a channel termination **834** near the opposite end of the body **818**. The open channel **822** extends upward through the stem **824**, the stop disk **826**, and the rotation disk **828**.

The lamp holder **810** also includes two vertical alignment grooves **836** that extend from the top of the stem **824** downward to the shaped channel **820**. The lamp holder **810** also includes locking grooves **838** in the stop disk **826** that extend from the stem **824** to the outer edge of the stop disk **826**.

The reflector **812** has an insertion end **840** with two insertion prongs **842**. The reflector also has a semi-circular insertion hole **844** near the insertion end **840**. The insertion hole **844** is used to mount the reflector **812** to the body **818**, as described below.

The retention plug **814** includes a cap **846**, a base **848**, an insert arm **850**, and a retaining arm **852**. The base **848** includes two insert rails **854** that extend from the cap **846** to approximately midway down the base **848**. The base **848** also includes an insert tab **882** on the side opposing the cap **846**.

The insert arm **850** includes a retaining tab **856** that branches downward from the end of the insert arm **850**. The retaining arm **852** includes two locking rails **858** that extend from the base **848** to the end of the retaining arm **852**. Each locking rail **858** has a flat top edge and an angled bottom edge. The retaining arm **852** also includes a retaining tab **856** that branches downward from the end of the retaining arm **852**.

Each contact clip **816** includes a tongue **860**, a riser **862**, contact fingers **868**, and a coupling wall **870**. The contact fingers **868** include angled portions **872** at the ends with a section of the contact finger **868** bent downward and another section of the contact finger **868** bent upward.

The wedge-base lamp holder **108** is assembled by inserting the contact fingers **868** on the contact clips **816** into the shaped channel **820**. The tongues **860** are placed facing outward and resting in recesses **874** at the top of the stem **824**. The reflectors **812** then are placed on top of the base **848** with the insertion ends **840** facing the center of the lamp holder **810**. The insertion prongs **842** on the reflector **812** are slid into insertion grooves **876** (FIG. **29**) located at the bottom of the stem **824** where the stem **824** meets the body **818**.

Next, the retention plug **814** is inserted down into the body **818** with the insert arm **850** facing the channel termination **834** and the retention arm **852** facing the open end **832**. The insert rails **854** on the retention plug **814** are aligned with and inserted into the alignment grooves **836** in the stem **824** of the body **818**. Also, the retaining tabs **856** on the insert arm **850** and the retaining arm **852** of the retention plug **814** slide into the insertion holes **844** in the reflectors **812**.

As illustrated in FIGS. **31** and **32**, as the retention plug **814** slides downward into the holder **810**, the locking rails **858** on the retention plug **814** lock into the locking grooves **838** on the stop disk **826** and the insert tab or extension **882** on the base **848** fits into a notch or slot **880** in the bottom of the shaped channel **820**. Inserting the extension **882** within the base slot **880** limits the movement of the retention plug **814** relative to the body **818**.

The wedge-base lamp holder **108** is installed in the track network in a manner similar to that of the interface **103** shown in FIG. **9**. The wedge-base lamp holder **108** is installed into the track network **101** with the cap **846** facing the track network **101** and is inserted into the opening **113**. The tongues **860** of the contact clips **816** are placed in the lower channel **120** and the rotation disk **828** is placed in the upper channel **115**. The stop disk **826** rests on the track frame **112** above the opening **113** to prevent over-insertion of the wedge-base lamp holder **108** in the track network **101**. The wedge-base lamp holder **108** is rotated approximately 90 degrees relative to the track frame **112**, tightly wedging

the rotation disk **828** into the upper channel **115** and causing the tongues **860** of the contact clips **816** to make an electrical connection with the track network conductors **125**.

Referring to FIG. **33**, a rotation lock light fixture **109** includes a front housing **905**, a rear housing **910**, a pivot mechanism **110** that operates in the same way as the pivot mechanism **106** described above with respect to FIG. **18**, an electrical wire **907**, and an interface **103** (as described above with respect to FIG. **9**). The rotation lock light fixture **109** is useful in applications such as under cabinet or cove lighting. For example, the light fixture can be pivoted to illustrate the wall behind and underneath a cabinet. It also can be used to illustrate a work area under the cabinet.

Referring to FIG. **34**, the front housing **905** includes a lens **912**, a lens aperture **914**, a front lip **916**, a front edge **918**, a front cavity **920**, engagement arms **922**, vents **924**, and ridges **926**. Referring also to FIG. **35**, the rear housing **910** includes a rear lip **928**, engagement platforms **930**, a rear edge **932**, a rear cavity **934**, reflector braces **936**, posts **938**, screw mounts **940**, a contact platform **942**, vents **944**, an arm **946**, and a portion **988** of the pivot mechanism **110**. The front housing **905** and the rear housing **910** are configured to be mated, as described below. The mated housings **905** and **910** are further configured such that the vents **924** and **944** on the respective housings are aligned for air circulation and cooling within the mated housings **905**, **910**. For example, as heated air rises and passes through the vents **924** in the front housing **905**, cool air will be pulled into the vents **944** in the rear housing **910**. However, the vents **924** and **944** can be configured in other arrangements to cause the air to pass laterally through the housings **905**, **910** before passing out of the housings. Moreover, the number and shape of the vents **924** and **944** can be varied for functional and decorative purposes.

Referring to FIG. **36**, a contact block **950** is mounted on the contact platform **942** of the rear housing **910**. The contact block **950** has a wiring clip and wiring holes (not shown) for connection to external electrical wiring. The contact block **950** also has mounting holes **952** for mounting the contact block **950** to the rear housing **910** and bulb insert holes **954** for inserting light bulb conductors into the contact block **950**.

Referring to FIG. **37**, the rotation lock light fixture **109** also includes a reflector **956** and a light bulb **958** installed in the rear housing **910**. The reflector **956** includes a recess **960**, a contact opening **962**, brace holes **963**, and mounting holes **964**. The reflector **956** is prepared for mounting to the rear housing **910** by aligning the brace holes **963** with the reflector braces **936** on the rear housing **910** and putting the posts **938** into the brace holes **963**. The contact block **950** and the reflector **956** are attached to the rear housing with screws **966** that are inserted into the mounting holes **964** on the reflector **956** and inserted into the mounting holes **952** on the contact block **950**. The screws then are threaded down into the screw mounts **940** on the rear housing **910**. Next, conductor tips **968** on the light bulb **958** are passed through the contact opening **962** on the reflector **956** and inserted into the bulb insert holes **954** on the contact block **950**.

Referring to FIG. **38**, the rotation lock light fixture **109** further includes protrusions **970** extending from an inside surface of the front lip **916** of the front housing **905**. Corresponding recesses **972** are formed on an edge surface of the rear lip **928** of the rear housing **910**. The rotation lock light fixture **109** is assembled by aligning the engagement arms **922** on the front housing **905** with the engagement platforms **930** on the rear housing **910**. The front housing **905** and the rear housing **910** then are pressed together as represented by Arrow A so that the front lip **916** overlaps the rear lip **928** and the front edge contacts the rear edge. The front housing **905** is then rotated in a clockwise direction as represented by Arrow B while the rear housing **910** is held in a fixed position until the engagement arms **922** are locked into the engagement platforms **930** and the protrusions **970** are positioned in the recesses **972**.

A number of implementations have been described. Other implementations are within the scope of the following claims.

What is claimed is:

1. A track lighting fixture comprising:

a first housing half having a surface, an inner perimeter, at least one recess in the surface, and at least one mating ramp extending from the inner perimeter; and

a second housing half having a surface, at least one protrusion extending from the surface, and at least one mating arm extending from the surface,

wherein the protrusion is configured to fit within the recess and the mating arm is configured to mate with the mating ramp when the first housing half is mated to the second housing half.

2. The track lighting fixture of claim **1** wherein the mating ramp includes a first segment generally parallel to the inner perimeter and a second segment extending from the first segment and configured to stop the movement of the mating arm when the mating arm is mated with the mating ramp.

3. The track lighting fixture of claim **2** wherein the mating arm includes a first segment extending from the surface of the second housing and a second segment extending from the first segment and a surface of the first segment of the mating ramp is adjacent to a surface of the second segment of the mating arm when the first housing half is mated to the second housing half.

4. The track lighting fixture of claim **2** wherein the mating of the mating arm with the mating ramp comprises a friction fit mating.

5. The track lighting fixture of claim **1** wherein the fitting of the protrusion within the recess comprises a positive lock between the first housing half and the second housing half.

6. The track lighting fixture of claim **3** wherein the first housing half and the second housing half are configured to be mated by rotational movement of the first housing half relative to the second housing half.

7. The track lighting fixture of claim **6** wherein the rotational movement of the first housing half relative to the second housing half comprises a non-engagement movement portion between the mating ramp and the mating arm and an engaged movement portion between the mating ramp and the mating arm.

8. The track lighting fixture of claim **7** wherein the non-engagement movement portion comprises the protrusion being in contact with the surface of the first housing half.

9. The track lighting fixture of claim **7** wherein the engaged movement portion comprises the protrusion being in contact with the surface of the first housing half and the second segment of the mating arm being engaged with the first segment of the mating ramp, whereby the contact between the surface of the first housing half and the protrusion causes the engagement of the second segment of the mating arm with the first segment of the mating ramp to be under compression.

10. The track lighting fixture of claim **7** wherein the rotational movement of the first housing half relative to the second housing half further comprises a non-engaged por-

tion between the mating ramp and the mating arm in which the protrusion is loosely within the recess and there is a loose engagement of the second segment of the mating arm with the first segment of the mating ramp.

11. The track lighting fixture of claim **1** wherein one of the first housing half and the second housing half includes a reflector and the other of the first housing half and the second housing half includes at least one prong extending from the respective housing half, whereby the prong is adjacent to an edge of the reflector when the first housing half is mated with the second housing half.

12. The track lighting fixture of claim **1** wherein the first housing half and the second housing half include vent holes configured to vent heat generated by operation of a lamp within the mated first housing half and second housing half.

13. The track lighting fixture of claim **12** wherein the vent holes in the first housing half and the vent holes in the second housing half are aligned when the first housing half is mated with the second housing half.

14. A method of mating a first housing half of a lighting fixture to a second housing half of a lighting fixture, the method comprising:

providing a first housing half having a surface, an inner perimeter, at least one recess in the surface, and at least one mating ramp extending from the inner perimeter;

providing a second housing half having a surface, at least one protrusion extending from the surface, and at least one mating arm extending from the surface;

placing the first housing half against the second housing half; and

rotating the first housing half relative to the second housing half until the protrusion is within the recess and the mating arm is mated with the mating ramp.

15. The method of claim **14** wherein the mating ramp includes a first segment generally parallel to the inner perimeter and a second segment extending from the first segment, and

rotating the first housing half relative to the second housing half further comprises rotating until the second segment of the mating arm stops the movement of the mating arm.

16. The method of claim **14** wherein the mating arm includes a first segment extending from the surface of the second housing and a second segment extending from the first segment, and

rotating the first housing half relative to the second housing half further comprises rotating until a surface of the first segment of the mating ramp is adjacent to a surface of the second segment of the mating arm.

17. The method of claim **14** wherein rotating the first housing half relative to the second housing half until the protrusion is within the recess and the mating arm is mated with the mating ramp comprises forming a positive lock between the first housing half and the second housing half.

18. The method of claim **14** wherein rotating the first housing half relative to the second housing half until the mating arm is mated with the mating ramp comprises forming a friction fit between the mating arm and the mating ramp.

19. The method of claim **14** wherein rotating the first housing half relative to the second housing half comprises:

rotating through a non-engagement movement portion between the mating ramp and the mating arm; and

rotating through an engaged movement portion between the mating ramp and the mating arm.

20. The method of claim **19** wherein rotating through the non-engagement movement portion further comprises rotating first housing half relative to the second housing half such that the protrusion is in contact with the surface of the first housing half.

21. The method of claim **19** wherein:

the mating ramp includes a first segment that is generally parallel to the inner perimeter and a second segment extending from the first segment;

the mating arm includes a first segment extending from the surface of the second housing and a second segment extending from the first segment; and

rotating through the engaged movement portion comprises rotating the first housing half relative to the second housing half such that the protrusion is in contact with the surface of the first housing half and the second segment of the mating arm is engaged with the first segment of the mating ramp,

whereby the contact between the surface of the first housing half and the protrusion causes the engagement of the second segment of the mating arm with the first segment of the mating ramp to be under compression.

22. The method of claim **19** wherein rotating the first housing half relative to the second housing half further comprises rotating to a non-engaged portion between the mating ramp and the mating arm, whereby the protrusion fits loosely within recess and the second segment of the mating arm is loosely engaged with the first segment of the mating ramp.

23. The method of claim **14** wherein:

the first housing half and the second housing half include vent holes configured to vent heat generated by operation of a lamp within the mated first housing half and second housing half; and

rotating the first housing half relative to the second housing half comprises rotating until the vent holes in the first housing half and the vent holes in the second housing half are aligned.

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